

REPORT DOCUMENTATION PAGE

*Form Approved
OMB No. 0704-0188*

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (From - To)		
1919	Bibliography	1918-1919		
4. TITLE AND SUBTITLE		5a. CONTRACT NUMBER		
American University Technical Reports, Bureau of Mines, War Gas Investigations (WGI) Monographs		5b. GRANT NUMBER		
		5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)		5d. PROJECT NUMBER		
		5e. TASK NUMBER		
		5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)			8. PERFORMING ORGANIZATION REPORT NUMBER	
Bureau of Mines				
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
Edgewood Arsenal, MD			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A; Approved for Public Release.				
13. SUPPLEMENTARY NOTES				
14. ABSTRACT				
15. SUBJECT TERMS Chemical warfare agents				
16. SECURITY CLASSIFICATION OF:		17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT			c. THIS PAGE



DEPARTMENT OF THE ARMY
US ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND
EDGEWOOD CHEMICAL BIOLOGICAL CENTER
5183 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MD 21010-5424

REPLY TO
ATTENTION OF:

RDCB-DPS-RS

APR 14 2015

MEMORANDUM THRU Director, Edgewood Chemical Biological Center (ECBC),
(RDCB-D, Mr. Joseph L. Corriveau), 5183 Blackhawk Road, Aberdeen Proving Ground,
MD 21010-5424

FOR Office of the Chief Counsel, US Army Research, Development and Engineering
Command (RDECOM), (AMSRD-CCF/Ms. Kelly Knapp), 3071 Aberdeen Boulevard,
Aberdeen Proving Ground, MD 21005-5424

SUBJECT: Operations Security/Freedom of Information Act (FOIA) Review Request

1. The purpose of this memorandum is to recommend the release of information in regard to request to RDECOM FOIA Requests FA-14-0054.
2. ECBC received the request from Ms. Kelly Knapp, the RDECOM FOIA Officer. The request originated from [REDACTED]
[REDACTED].
3. The following documents were reviewed by Subject Matter Experts within ECBC:
 - a. History of Research at Yale University, dated 20 Nov 1918, 11 pages.
 - b. Bancroft's History of the Chemical Warfare Service in the United States, by Lt. William Bancroft; AD-495049; dated 31 May 1919, 206 pages.
 - c. A Historical Sketch of Edgewood Arsenal, by Lt. William McPherson; AD 498494; date unknown, 20 pages.
 - d. The Diary of Jet Parker; C390D1; dated Sep - Dec 1918, 26 pages.
 - e. American University Technical Reports, Bureau of Mines, War Gas Investigations (WGI) Monographs, date unknown.

RDCB-DPS-RS

SUBJECT: Operations Security/Freedom of Information Act (FOIA) Review Request

4. ECBC has determined that all of the reviewed documents are suitable for release, however, all documents must have the classification/distribution changed through the Defense Technical Information Center prior to any release.

5. The point of contact is Mr. Ronald L. Stafford, ECBC Security Manager, (410) 436-1999 or ronald.l.stafford.civ@mail.mil.



RONALD L. STAFFORD
Security Manager

AMERICAN UNIVERSITY TECHNICAL REPORTS

BUREAU OF MINES WAR GAS INVESTIGATIONS (WGI) MONOGRAPHS (OLD SERIES):

WGI 1: Dichloroethyl Sulfide (Mustard) and Homologues, Clarence J. West, Part I (revised), 1 Aug 1918 and Part II (revised), 30 Aug 1918

Part I

I	Dichloroethyl Sulfide	
1	Introduction	1
2	Preparation	2
3	Possible use of Ethylene dihalides	5
4	Nature of Diethylene disulfide	10
5	Possible use of Ethyl sulfide	13
6	German method of manufacture	13
7	Manufacture	
	A. Chlorhydrin method	15
	1. Ethylene	16
	2. Ethylene Chlorhydrin	25
	3. Thiodiglycol	45
	4. Dichloroethyl Sulfide	53
	5. Disadvantages	55
	B. Sulfur Dichloride method	56
	C. Sulfur Monochloride method	65
	Sulfur	87
	D. Manufacturing Details	97
	E. Methods of Purification	98
	F. Mechanism of the Reaction	104a
8	Test of Purity	105
9	Properties of Mustard Gas – Physical	108
10	Chemical Reactions	123
11	Action of Metals	130
12	Hydrolysis	133
13	Detection	139
	Chemical	139
	Biological	151
14	Analysis	155
15	Testing Efficiency of Canisters	162
16	Time of Permeation	165
17	Protection	170
	Masks	171
	Permeability of fabrics	175
18	Protection – Fabrics	176
19	Protection – Clothing	184

20	Protection – Dugouts	193
21	Protection – Individual	193
22	Protection – Collective	193
23	Protective Ointments	195
24	Yellow Cross Shells	195
25	Composition of Yellow Cross Shell liquid	202
26	Shell filling	204
27	Bombardment	208
28	Persistence	214
29	Cause of Casualties	217
30	Tactical use of Mustard Gas	222
31	Military Value	231
<u>II</u>	<u>Homologues of Mustard Gas</u>	
32	Dichloropropyl Sulfide	234
33	Butyl Analogue	243
34	Glycerol Analogue	243
<u>III</u>	<u>Various Chlorinated Organic Sulfides</u>	
35	Dichloro methyl sulfide	244
36	Tetrachloro methyl sulfide	244
37	Perchloromethyl sulfide	245
38	B-chloroethyl sulfide	246
39	Tetrachloroethyl sulfide	248
40	Hexachloroethyl sulfide	249
41	Chloroethylmethyl sulfide	250
42	Dibromoethyl sulfide	251
43	Diiodo ethyl sulfide	253
<u>IV</u>	<u>Mixtures</u>	
44	Hydrocyanic acid	254
45	Bromacetone	262
46	Bromxylol	263
47	Carbontetrachloride	264
48	Other Materials	264
V	Part II	
	<u>Destruction and Removal</u>	
49	Laboratory	266
50	Aqueous solutions	267
51	Clothing	269
52	Body	275
53	Air	278
54	Ground	279
55	Wood, Linoleum	285
56	Gun Parts	286
57	Disinfection in Field	287
58	Precautions for the Field	289
	Care of Clothing	289
	Care of Body	291
	Care of Food	292
59	Suggestion for Factory Protection	293
<u>VI</u>	<u>Physiology</u>	
60	Transformation Diagram (Plate XL)	296
61	Effects on Animals	297
	Mice	297

Cats	297
Rabbits	298
Dogs	298
Symptomatology	299
62 Action on Man	306
63 Toxicity of Mustard Gas	313
64 Physiological Effects of Mustard Gas and the Absorption through the Lungs and Skin	315
Method	316
Injection	317
Inhalation	320
Absorption through the skin	322
Mode of Action	323
65 Limit of Detection by Odor	327
VII	<u>Skin Irritant Properties</u>
66 Methods of Testing Skin Irritant Properties	330
Test Tube Vapor Method	331
Touch Method	333
Square Centimeter Method	333
67 Superficial aspects of the Action of Mustard Gas on the: Skin of Monkey, Cat, Goat, Guinea Pig, Horse, Rabbit, and Dog	336
68 Action of Dichloroethyl sulfide on Human Skin	345
69 Individual Variation in Susceptibility to Mustard Gas	345
Sweating	353
Moisture	355
Practical Applications	356
70 Minimum Burning Concentration of Mustard Gas in Oils	360
71 Value of Different Preparations	361
Value of diluents	363
VIII	<u>Pathology of Poisoning by Mustard Gas</u>
72 Pathological Anatomy	367
73 Pathology of Skin Lesions	381
74 Effect of Subcutaneous or Intravenous Injection	389
75 Changes in the manifestations of Yperite Lesions	390
76 Correlation of Nature of Pathologic Lesions in Skin with Precipitation of Proteins	392
IX	<u>Dichloropropyl Sulfide</u>
77 Dichloropropyl Sulfide	394
78 Dibromopropyl Sulfide	398
79 Pathology	398
X	<u>Treatment</u>
80 Protection	399
Oils	401
Ointments	405
81 Removal	426
82 Therapy of Mustard Gas Burns	429
83 Treatment of Blisters	439
84 General Treatment	441
Bibliography	
Index	

WGI 4: Phosgene, Clarence J. West, 24 May 1918

I	Introduction	1
II	Methods of Formation and Preparation	2
III	Formation from Chloroform by heat	11
	Manufacture	12
	Carbon Monoxide	12
	Preparation	12
	Removal of dust	17
	Removal of gaseous impurities	18
	Chlorine	19
	Mixing the gases	20
	Catalysers	21
	Catalytic apparatus	23
	Liquefaction of phosgene	26
	Recovery of uncondensed Phosgene	29
	Destruction of uncondensed Phosgene	30
	Cost of manufacture	31
	Carbon Tetrachloride method	32
	Phosgene and Arsenic Trichloride	33
	German manufacture	34
	Factory conditions	34
IV	Physical properties	37
V	Chemical properties	38
VI	Decomposition in presence of water vapor	40
VII	Corrosion tests	44
VIII	Detection	52
	Test papers	52
	Color chart	52-b
	Detectors	52
IX	Analysis	55
	Air	55
	In presence of Hydrochloric acid	58
X	Detection of Chlorine and Phosgene	58
XI	Free Chlorine in Phosgene	60
	Analysis of air containing Chlorine for Phosgene	64
XII	Testing of absorbents and canisters	65
	Absorbents	65
	Accelerated method	69
	Multiple tube	71
	British method	76
XIII	Bactericidal power	83
XIV	Physiological properties	83
XV	Effect of varying concentrations	85
XVI	Toxicity	89
XVII	Sensitiveness of individual	89
XVIII	Limit of detection by smell	91
XIX	Action on blood	92
XX	Effect on urine	95
XXI	Effect on taste	95
XXII	Histological findings	96
XXIII	Pathological action	96
XXIV	Phosgene poisoning	125

<u>XXV</u>	Treatment	136
<u>XXVI</u>	Absorption	138
	Charcoal	138
	Effect of heating	138
	Effect of humidity	140
	Catalytic activity	142
	Comparison of absorptive values	144
	Soda Lime	144
	Distribution between Charcoal and Soda Lime	145
	Peroxide granules	152
	Patrick absorbent	153
	Copper oxide	153
<u>XXVII</u>	Permeability	153
<u>XXVIII</u>	Protection	155
	Russian formula	155
	British mask	158
	German mask	159
	Russian mask	159
	American mask	160
	Comparison of mask	163
<u>XIX</u>	Shell filling	167
<u>XXX</u>	Tactical use	171
	Gas waves	171
	Gas shells	172
	Bombardments	178
	English use	179
<u>XXXI</u>	Firing trial	181
	Lethal travel	182
<u>XXXII</u>	Military value	183
	Amount of Phosgene used	185
	Effect of rain on Phosgene cloud	185
	Chlorine and Phosgene	186
	Thiophosgene	188
	Formation	188
	Preparation	188
	Properties	191
	Detection	194
	Estimation	194
	Physiological properties	195
	Protection	197
	British mask	197
	German mask	197

WGI 6: Silicon Tetrachloride, Austin M. Patterson and Clarence J. West, 22 June 1918

<u>I</u>	Formation	1
<u>II</u>	Preparation	7
	1. Silica, Carbon, and Chlorine	7
	2. Silica and Chlorine	9
	3. Silica, Magnesium, and Chlorine	12
	4. Silica, Aluminum, and Chlorine	14
	5. Silicon alloys and Chlorine	15
	6. Silicon and Chlorides	21

<u>III</u>	Purification	21
	Preservation	22
<u>IV</u>	Manufacture	22
<u>V</u>	Physical Properties	23
<u>VI</u>	Inorganic Reactions	31
<u>VII</u>	Organic Reactions	43
<u>VIII</u>	Action on Metals	49
<u>VIII-a</u>	Mixture	52
<u>IX</u>	Analysis	53
<u>X</u>	Physiology	54
<u>XI</u>	Smoke Production	54
<u>XII</u>	Berger Smoke Mixture	64
<u>XIII</u>	Bureau of Mines Smoke Box	66
<u>XIV</u>	Use in Shells	76
<u>XV</u>	Relative Value	79
<u>XVI</u>	Plugging of Mask	82
<u>XVII</u>	Filters	83
<u>XVIII</u>	Protection	83
<u>XIX</u>	Effect on life of canisters	85

WGI 7: Titanium Tetrachloride, Austin M. Patterson and Clarence J. West, 25 Jun 1918

<u>I</u>	Formation	1
<u>II</u>	Preparation	4
<u>III</u>	Purification	9
<u>IV</u>	Preservation	11
<u>V</u>	Manufacture	11
<u>VI</u>	Physical Properties	14
<u>VII</u>	Aqueous Solution	18
<u>VIII</u>	Inorganic Reactions	19
<u>IX</u>	Organic Reactions	30
<u>X</u>	Acting on Metals	36
<u>XI</u>	Analysis	36
	Canister Tests	37
<u>XII</u>	Physiology	39
<u>XIII</u>	Smoke Production	39
<u>XIV</u>	Berger Mixture	41
<u>XV</u>	Use in Shells	42
<u>XVI</u>	Comparison with Phosphorus	43
<u>XVII</u>	Relative Value	45
<u>XVIII</u>	Protection	46

WGI 8: Tin Tetrachloride, Austin M. Patterson and Clarence J. West, 26 Jun 1918

<u>I</u>	Discovery	1
<u>II</u>	Formation	1
<u>III</u>	Preparation	
	Tin and Chlorides	5
	Tin, Sulfuric acid, and Salt	5
	Tin and Chlorine	6
	Tin oxide, Reducers, and Chlorine	8
	Tin oxide and Chlorides	9

	Stannic oxide and Hydrochloric acid	10
	Stannous chloride solution	11
<u>IV</u>	Manufacture	12
<u>V</u>	Purification	15
<u>VI</u>	Preservation	16
<u>VII</u>	Physical Properties	16
<u>VIII</u>	The Aqueous solution and hydrates	27
<u>IX</u>	Inorganic Reactions	32
<u>X</u>	Organic Reactions	38
<u>XI</u>	Action on metals	44
<u>XII</u>	Analysis	47
<u>XIII</u>	Test of Box Respirator	49
<u>XIV</u>	Filters	50
<u>XV</u>	Position of Filter Pads	52
<u>XVI</u>	Other Filtering Materials	
	Flannel filter pad	53
	Flannel filter bag	54
	Rubber Sponge	54
	“Filtros” Silica Filter Plates	54
	Sponge saturated with glycerol	54
	Celite ‘Filter Cel’	54
	Other filtering media	55
	Felt as a smoke filter	55
	Method of attaching bag filter	57
	Filter cartridge	58
<u>XVII</u>	Physiological	59
<u>XVIII</u>	Smoke Production	59
<u>XIX</u>	Comparison with Phosphorus	66
<u>XX</u>	Stannic Ammonium chloride	67
<u>XXI</u>	Shells	68
<u>XXII</u>	Incendiary Bomb	69
<u>XXIII</u>	Relative Value	70
<u>XXIV</u>	Comparison of Canisters	72
<u>XXV</u>	Effect on life of canister	73
<u>XXVI</u>	Mixtures	
	Phosgene	74
	Phosgene, Arsenic trichloride, and Stannic chloride	74
	Chloropicrin	75
	CBR II	75
	Hydrocyanic acid	81
	Green Star	82

WGI 9: Soda Lime Granules, Stuart J. Lloyd and Clarence J. West, 6 Jul 1918

<u>I</u>	Introduction	1
<u>II</u>	Soda Lime	1
	History	1
	Preparation	4
	Use	7
	Mode of Action	8
	Work of Vetali and Guareschi	8
<u>III</u>	Development of Cement Granules	10
	British Experience	10

	American Experience	13
<u>IV</u>	Manufacture of Cement Granules	16
	British Procedure	16
	Former American Practice (Easton)	17
	Squirting	19
	Drying	19
	Grinding	20
	Time of Setting	20
	Spraying of Permanganate	20
	Autoclaving	21
	Border Space	21
	Corrosion of Trays	22
<u>V</u>	Comparison of British F.77 Granules, and average American A-25 B.	23
<u>VI</u>	Raw Materials	28
	Lime	28
	British Experience	28
	American Experience	28
	Analysis and Specifications	29
	<u>Kieselguhr</u>	33
	Comparison of British & American Analysis and Specifications	33 34
	<u>Portland Cement</u>	37
	British & American Practice	37
	Substitutes	38
	Analysis and Specifications	39
	<u>Caustic Soda</u>	43
	Substitutes	44
<u>VII</u> A.	Sodium Permanganate	45
	History of use	45
	Carbon Dioxide Process	46
	British Chlorine Process	47
	Early American Materials	47
	American Chlorine Method	48
	Partial Carbonation Method	56
	Electrolytic Method	59
	Leaching of Fines for Permanganate	61
	Evaporation of Permanganate Solutions	67
	Analysis	76
	Specifications	95
B.	Calcium Permanganate	95
<u>VIII</u>	Properties of Granules	97
	Absorption of Gases	97
	Chlorine	98
	Phosgene	99
	Superalite	101
	Mustard Gas	102
	Arsine	102
	Arsenic fluoride	105
	Diphenylchlorarsine	106
	Hydrocyanic acid	107
	Cyanogen chloride	108
	Cyanogen bromide	108
	Cyanogen	109

	Hydrofluoric acid	110
	Xylyl and Benzyl bromides	110
	Chloropicrin	111
	Apparent Density	111
	Hardness	113
	Fineness & Chemical Efficiency	114
	Canister Filling	116
<u>IX</u>	Substitutes	117
	Calcium permanganate	118
	Analytical Method for BaMnO ₄ fusion	119
	Copper oxide in Granules	123
	Ferric hydroxide in Granules	124
	British "Gray Granules"	124
	British "White Granules"	125
	French Granules	126
	Charcoal Fines in Sodium hydroxide	126
	Sodium hydroxide in Charcoal	127
	Whetlerite A	129
	Whetlerite B	130
	Permutite	130

CHEMICAL WARFARE MONOGRAPHS (CWM):

CWM 1: Theoretical Considerations on Canister Filling, Clarence J. West, Mar 1918

I	The Development of the Standard Army Canister	1
	Type A	2
	Type B	5
	Type C	6
	Type D	6
	Type E	7
	Type F	7
	Type G	8
	Type H	9
	Type J	9
	Type K	10
	Type L	11
II	Wave Front Study	12
	Apparatus	12
	Hydrogen sulfide Generator	12
	Humidity Controller	14
	Method of Procedure	16
	Plotting Wave Fronts	19
	Method of Filling	20
	Course of Gas through Cylinder	27
	Wave Fronts	
	Type G Canister	27
	Types H and J Canisters	35
	Low resistance canisters	35
	Little, Type II, canister	38
	Logan canister	40

	Revised Logan canister	41
	English canister	42
	Runals, Type 15, Low resistance canister	43
	Industrial canister	44
III	Relative Proportions of Absorbents	47
	Machine Test	47
	Man House Test	48
IV	Varying Distribution of Size of Absorbent in Different Layers	53
V	Position of Absorbent	62
VI	Optimum Grain Size of Absorbent Tube Tests	75
	Low resistance canister	83
	Central breathing canisters	91
	Bibliography	
	Index	

CWM 2: Testing of Gas Masks (Part I) and Absorbent Testing (Part II), Clarence J. West, Mar 1919

	Part I	
XIX	<u>Superpalite Tube Test</u>	126
	Procedure	129
	Adjustment of Flow of Air and Superpalite	129
	Determination of Concentration	130
	Manipulation for the Test	130
	Analysis	132
	Apparatus and Procedure	135
XX	<u>Standard Sulfur Dioxide Method</u>	141
	Apparatus	141
	Procedure	142
	Adjustment of Flow of Air and Sulfur Dioxide	142
	Determination of Concentration	143
	Manipulation for the Test	144
	Analysis	145
	Solutions	146
XXI	<u>A Two Tube Apparatus for Testing Absorbents with Binary Gas Mixtures</u>	150
	Apparatus	150
XXII	<u>Method for Testing Special Soda Limes for Carbon Dioxide Absorption</u>	154
	Method	155
	Apparatus	156
	Procedure	158
	Adjustment of flow of Air and Carbon dioxide	158
	Determination of Concentration	159
	Manipulation for the Test	160
	Analysis	161
	Part II - Appendixes	
I	<u>Flow Meters</u>	167
	Capillary Flow Meters	167
	Types of Flow Meters	182
	Investigation of Resistance Tube Flow Meters	196

	Calibration of very small Flow Meters	216
<u>II</u>	<u>Proposed Standard Tests on 12-24 Mesh Material</u>	226
	Introduction	226
	Test Results	232
<u>III</u>	<u>Tube Tests on Carbon Monoxide</u>	247-a
	Introduction	247-a
	General Method of Procedure in Making Tests	247-a
	Tests at Ice Temperature	249
	Concentration of Mixing of Gas	252
	Rate of Flow	253
	Humidification of the Gas	255
	Standard Tube, Absorbent, Filling, etc.	256
	Analysis: Determination of Carbon Monoxide by the Iodine Pentoxyde Method	259
	Measurement of Sample of Gas	260
	Procedure	260
	Electrically Heated Oil Bath	264
	Cleaning the Trains	265
	Absorption Bulbs	265
	Solutions	266
<u>IV</u>	<u>Method of Determining the Adsorptive Capacity of Powders</u>	267

CWM 3: Testing of Gas Masks (Part II), Canister Testing, Clarence J. West, Mar 1919

I	Introduction	1
	Physical Examination	2
	Abnormal pressure drop	2
	Abnormal efficient life	4
II	Separation of constituents of war gas mixture	6
III	Apparatus for detection of leaks	10
IV	Apparatus for measurement of pressure drop	11
V	Obtaining concentration of gases	12
	Production of gas mixtures from small amounts of liquids	17
VI	Notes and Precautions on routine canister testing	24
VII	Sources of error in canister testing	26
VIII	Determination of efficiency or life of canisters against various gases	37
IX	Chlorine	39
X	Chloropicrin	44
XI	Phosgene	50
XII	Hydrocyanic acid	53
XIII	Superpalite	57
XIV	Thiophosgene	60
XV	Cyanogen chloride	64
XVI	Cyanogen bromide	67
XVII	Dichloroethylsulfide	70
XVIII	Perchloroethyl mercaptan	73
XIX	Acrolein	76
XX	Chloroacetone	80
XXI	Benzyl and xylyl bromide	83
XXII	Brombenzyl cyanide	86

XXIII	Phenylcarbylamine chloride	89
XXIV	Chloroacetophenone	93
XXV	2-4 Dichlorobenzyl bromide	97
XXVI	Arsine	101
XXVII	Methyldichloroarsine	105
XXVIII	Phenyldichloroarsine	108
XXIX	Diphenylchloroarsine	112
XXX	Diphenylcyanoarsine	116
XXXI	Carbon monoxide	121
XXXII	Ammonia	124
XXXIII	Hydrogen chloride	127
XXXIV	Sulfur dioxide	129
XXXV	Sulfur dichloride	132
XXXVI	Sulfur monochloride	134
XXXVII	Carbon disulfide	135
XXXVIII	Dimethyl sulfate	139
XXXIX	Chloroacetyl chloride	142
XL	Aniline	145
XLI	Ethyl chloride	146
XLII	Gasoline	150
XLIII	Testing canisters against mixed vapors of two liquids	151

CWM 4: Testing of Gas Masks (Part III), Intermittent Canister Testing Man House (Gas Chamber) Laboratory,
Clarence J. West, Mar 1919

Standard intermittent testing machine	2
Apparatus (Type C) for chloropicrin	5
Standard intermittent mercury valve	6
Standard intermittent mechanical valve	8
Effect of oscillation rate	10
The canister testing laboratory	11
Pressure drop machine	16
Physical examination of canisters	16
Multiple intermittent machine	17
General procedure of testing	23
Chlorine	24
Phosgene	27
Hydrocyanic acid	30
Chloropicrin	36
Humidifying machine	43
Duplex canister testing machine	46
Humidifying apparatus	48
Mixing chamber	49
Absorbing box	51
Method of obtaining concentrations	52
Gas chamber testing	53
Man test laboratory	55
General apparatus	56
Humidifier	63

Pressure drop and leak detecting apparatus	64
Detonation of solids and liquids	65
Substances gaseous at ordinary temperatures	67
Substances liquid at ordinary temperatures	69
Uniformity of gas concentrations	70
Methods of conducting tests	71
Type of masks used	73
Disinfection of masks	73
Applicability of man tests	74
New maximum work man test	75
Field test	84
Breathing rate	85
Canister for determining breathing rates	106
Equation for converting routine breathing rates of the American University into terms of the Long Island tests	115
Comparison of machine tests	117
Comparison of British and American intermittent machine tests	120
Relation between continuous and intermittent machine tests	126

CWM 5: Testing of Gas Masks (Part IV), Methods of Testing Filters and Canisters Against Smoke, Clarence J. West, Mar 1919 [2 copies]

Introduction	1
Diphenylchlorarsine	3
Testing fabrics, papers, etc.	4
Machine method	6
Man test	10
Ammonium chloride	24
Ammonium chloride machine	25
Apparatus	27
Methods of measuring filtering efficiency	32
Standard Ammonium chloride smoke	49
Martens photometer	51
Eastman duplex photometer	60
Arnold photometer	64
Tobacco smoke	69
Standard flange test	70
Canisters	80
Break point method of rating filters	85
Sulfuric acid smoke	88
Standard flange test	89
Canister tests	100
Comparison of methods	105
Correlation and comparison of smoke data	108
Man and machine tests on smoke papers	113

CWM 6: Testing of Gas Masks (Part V), Testing of Face Pieces, Clarence J. West, Mar 1919 [2 copies]

Introduction	1
Evaluation of mask	3
Standard field test No. 1	8
Standard field test No. 2	9
Standard field test No. 3	11
Defining power of eyepieces	14
Co-ordination of vision and muscular activity	17
Sighting tests	19
Discrimination apparatus	21
Standard field test No. 4	22
Determination of maximum tension exerted by harness of the mask	27
Determination of pressure exerted by parts of the mask	28
Testing leakage of masks	29
Determining the gas-tightness of a mask	31
Standard field test No. 5	34
Standard field test No. 6	35
Inhalation resistance of gas masks	37
Determination of dead air space	38
Resistance of exhalation valve	41
Valve leakage	45
Durability of valves	46
Comparison of head measurements	46

CWM 7: Testing of Gas Masks (Part VI), Methods of Analysis, Clarence J. West, March 1919

Methods of Analysis for Toxic Gases	
Acrolein	2
Adamsite (DM)	2
Ammonia	3
Arsine	4
Bromobenzyl cyanide	5
Benzyl bromide	5
Carbon bisulfide	6
Carbon monoxide	6
Chlorine	6
Chloroacetophenone	6
Chloroacetyl chloride	7
Chloropicrin	7
Cyanogen	8
Cyanogen and Hydrocyanic acid	8
Cyanogen bromide	8
Cyanogen chloride	9
Cyanogen chloride and chloropicrin	11
Dichlorobenzyl bromide	12
Dichloroethyl sulfide	12
Dimethyl sulfate	13
Diphenylchlorarsine	14
Diphenylcyanoarsine	16
Hydrocyanic acid	17

Methyldichloroarsine	17
Monochloracetone	17
Perchlormethyl mercaptan	18
Phosgene	18
Phenylcarbylamine chloride	19
Phenyldichloroarsine	19
Sulfur dioxide	20
Superpalite	20
Thiophosgene	20
Xylyl Bromide	21
Chemical Control of Man Tests.	
<u>Substances Introduced as Gases</u>	22
Ammonia	23
Chlorine	24
Phosgene	25
Sulfur dioxide	26
<u>Substances Atomized into Chamber</u>	27
Benzyl bromide	28
Chloropicrin	29
Cyanogen chloride	30
Methyldichloroarsine	31
Nitrogen peroxide	32
Silicon tetrachloride	33
Tin tetrachloride	34
Titanium tetrachloride	35
Xylyl bromide	37
<u>Substances Detonated in Chamber</u>	38
Brom benzyl cyanide	39
Chloracetophenone	40
Cyanogen bromide	40
Diphenylchloroarsine	41
Phenyldichloroarsine	47
<u>Standard Solutions</u>	48
Preparation of standard Sulfuric acid	51
Preparation of standard normal Alkali	58
Preparation of N/10 Iodine	62
Preparation of N/10 Arsenic trioxide	62
Preparation of N/10 Sodium thiosulphite	63
Preparation of N/100 Ammonium sulfocyanate	64
<u>Absorbent Solutions</u>	65
<u>Indicators</u>	65
<u>Conversion Factors</u>	66
Analysis of Gas Mixtures	67
<u>Phosgene Mixtures</u>	67
<u>Chloropicrin Mixtures</u>	73

CWM 8: Factors Influencing the Efficiency of Absorbents, Clarence J. West, Apr 1919

I	Absorption Values of Various Absorbents	2
II	Effect of Pressure on Adsorptive Power of Charcoal	13
III	Arrangement of Different Meshes	25
IV	Depth of Layer	33
V	Concentration and Rate of Flow	42

	Chloropicrin	42
	Phosgene	44
	Hydrocyanic acid	45
	Carbon monoxide	45
<u>VI</u>	Effect of Temperature	47
	Phosgene	47
	Chloropicrin	56
	Hydrocyanic acid	65
	Cyanogen chloride	74
	Arsine	82
	Carbon monoxide	89
<u>VII</u>	Effect of Humidity	92
	Phosgene	92
	Chloropicrin	131
	Arsine	146
	Hydrocyanic acid	154
	Carbon monoxide	157
<u>VIII</u>	The Aging of Charcoal	158
	The Aging of Soda Lime	159
	The Copper Content of Rankinite A	164

CWM 9: Factors Influencing the Efficiency of Canisters, Clarence J. West, Mar 1919

Description of canisters	1
Dimensions and resistance	2
Canister efficiency	3
Comparison of protection afforded by foreign and American canisters	27
Offensive value of various gas mixtures	33
Effect of temperature	38
Phosgene	39
Charcoal	42
Chloropicrin	44
Hydrocyanic acid	45
Charcoal	47
Soda lime	48
Comparison	50
Cyanogen chloride	51
Whetlerite	53
Summary	55
Effects of humidity	58
Phosgene	72
Effects of concentration	80
Arsine	80
Chloropicrin	83
Chlorine	85
Hydrocyanic acid	86
Phosgene	90
Cyanogen chloride	96
Effect of rate of flow	100
Phosgene	100
Chloropicrin	102
Continuous and intermittent flow	104

Effect of oscillation rate	111
Effect of reversing the flow of gas	120
Effect of periods of rest	123
Effect of aging	130

CWM 10: Fluorine and its Derivatives, Austin M. Patterson and Clarence J. West, 3 Aug 1918

<u>I</u>	<u>Fluorine</u>	
1.	Occurrence	1
2.	Formation and Preparation	2
3.	Manufacture	6
4.	Physical Properties	7
5.	Chemical Properties	8
6.	Reactions	9
7.	Physiological Effects	22
8.	Analysis	22
<u>II</u>	<u>Hydrofluoric Acid</u>	
1.	Occurrence and Formation	25
2.	Preparation of the Aqueous Acid	25
3.	Preparation of the Anhydrous Acid	30
4.	Properties of the Anhydrous Acid	36
5.	Properties of the Aqueous Acid	38
6.	Purification of the Aqueous Acid	38
7.	Preservation of the Aqueous Acid	40
8.	Physiological Effects	40
9.	Protection	41
<u>III</u>	<u>Bromine Fluoride</u>	
1.	Formation	44
2.	Preparation	44
3.	Physical Properties	45
4.	Reactions	45
5.	Physiological Effects	46
<u>IV</u>	<u>Iodine Fluoride</u>	
1.	Formation and Preparation	47
2.	Physical Properties	47
3.	Reactions	48
4.	Military Use	49
<u>V</u>	<u>Boron Fluoride</u>	
1.	Formation and Preparation	50
2.	Properties	52
3.	Inorganic Reactions	52
4.	Organic Reactions	53
<u>VI</u>	<u>Silicon Tetrafluoride</u>	
1.	Formation	56
2.	Preparation and Purification	57
3.	Physical Properties	57
4.	Reactions	58
<u>VII</u>	<u>Silicofluoroform</u>	
	Preparation and Properties	59
<u>VIII</u>	<u>Titanium Tetrafluoride</u>	
1.	Formation	60
2.	Preparation	61
3.	Physical Properties	62

	4. Reactions	62
<u>IX</u>	Stannic Fluoride	64
<u>X</u>	Nitrosyl Fluoride	65
<u>XI</u>	Nitryl Fluoride	66
<u>XII</u>	<u>Phosphorus Trifluoride</u>	
	1. Formation and Preparation	67
	2. Properties	69
	3. Reactions	70
	4. Military Use	71
<u>XIII</u>	<u>Phosphorus Pentafluoride</u>	
	1. Formation and Preparation	72
	2. Properties	73
	3. Reactions	73
<u>XIV</u>	Phosphorus Fluorochloride	74
<u>XV</u>	Phosphorus Fluorobromide	75
<u>XVI</u>	<u>Phosphorus Oxyfluoride</u>	
	1. Formation and Preparation	76
	2. Properties	77
	3. Reactions	77
<u>XVII</u>	<u>Phosphorus Sulfofluoride</u>	
	1. Formation and Preparation	78
	2. Properties	79
	3. Reactions	79
<u>XVIII</u>	<u>Arsenic Trifluoride</u>	
	1. Formation and Preparation	80
	2. Properties	81
	3. Reactions	82
	4. Preservation	84
	5. Analysis	84
	6. Physiological Effect	85
	7. Tactical Use	87
	8. Absorption Tests	87
<u>XIX</u>	<u>Arsenic Pentafluoride</u>	
	1. Formation and Preparation	89
	2. Properties	89
	3. Reactions	90
<u>XX</u>	<u>Antimony Pentafluoride</u>	
	1. Formation and Preparation	91
	2. Properties	91
	3. Reactions	92
<u>XXI</u>	Antimony Fluorochloride	93
<u>XXII</u>	Sulfur Hexafluoride	94
<u>XXIII</u>	<u>Thionyl Fluoride</u>	
	1. Formation and Preparation	95
	2. Physical Properties	96
	3. Reactions	96
	4. Analysis and Control in Air Mixture	97
	5. Physiological Effects	98
<u>XXIV</u>	Fluorosulfonic Acid	98
<u>XXV</u>	Bismuth Pentafluoride	99
<u>XXVI</u>	Osmium Octafluoride	100
<u>XXVII</u>	Lead Tetrafluoride Double Salts	101
<u>XXVIII</u>	Acid Fluorides	102

<u>XXIX</u>	<u>Organic Fluorine Compounds</u>	
1.	General	104
2.	Cacodyl fluoride	105
3.	Acetyl fluoride	106
4.	Trichloroacetyl fluoride	109
5.	Propionyl fluoride	109
6.	Dichlorofluoroacetyl fluoride	110
7.	Benzoyl fluoride	110
8.	p-Fluorobenzenesulfonyl chloride	112
9.	Bromofluoroacetic acid	112
10.	Fluorobenzene	112
11.	Carbonyl fluoride	113
12.	Oxalyl fluoride	113
13.	List of Fluoride Compounds Arranged by Formulas	114

Bibliography

Index

CWM 12: Screening Smokes, Stewart J. Lloyd and Clarence J. West, 25 Oct 1918 [old series]

I	<u>Introduction</u>	1
	<u>Smoke Production</u>	
	General	2
	Principles of Smoke Production	5
	Size of Smoke Particles	12
	Rate of settling	18
	Cottrell Smoke Precipitation Apparatus	22
	Classification	24
	Humidity	39
II	<u>Measurements</u>	
	Smoke Box	40
	Tyndall Meter	46
	Units employed	49
	Bomb Pit Measurements	55
III	<u>Zinc Containing Smokes</u>	
	Berger Mixture	58
	B.M. Standard Mixture	59
	Components	63
	Smoke Box or Float	78
	Smoke Candles	89
	Smoke Grenades	96
	Stokes' Smoke Shell	100
	Livens' Smoke Drum	101
	Similar Mixtures	103
	Permite Mixtures	104
	Zinc chloride Solution	105
	Zinc chloride in Shells	105
	Zinc oxide in Shells	105
	Burning metallic Zinc	106
IV	<u>Phosphorus Smokes</u>	
	General	108
	Use in Shells and Bombs	110
	Naval Smoke Shell	113

	Dummy Aerial Bomb Cartridge	116
	Training Smoke Bomb for 2" Projector	118
	Grenades	121
	German Capsules	122
<u>V</u>	<u>Chlorosulfonic Acid</u>	
	General	123
	German Generators	123
	Naval Use	129
	Smoke Funnel	129
	Artillery Shell	129
	Corrosion	130
	Miscellaneous	130
	Manufacture	131
<u>VI</u>	<u>Sulfur Trioxide</u>	
	Use in Shells and Bombs	135
<u>VII</u>	<u>Oleum</u>	
	Freezing Point Lowering	140
	Corrosion	141
	Naval Use	143
	Apparatus for Use	144
	Nozzles for Spraying	148
	Aeroplane Screen	148
	Tank Screen	150
	Detonation	150
<u>VIII</u>	<u>Silicon, Tin, and Titanium Tetrachlorides</u>	
	Silicon Tetrachloride	151
	Ammonia	152
	Smoke Funnel	155
	Compressing Medium	155
	Specifications	164
	Smoke Knapsack	169
	Smoke Float	173
	Use in Berger Mixture	174
	Use in Shells	174
	Hand Grenades	176
	Specifications	181
	Titanium Tetrachloride	183
	Smoke Funnel	186
	Verdier Apparatus	186
	Shells	186
	Grenades	189
	Berger Mixture	189
	Tin Tetrachloride	190
	Smoke Production	191
	Smoke Grenade	198
	Smoke Funnel	199
	Shells	199
<u>IX</u>	<u>Miscellaneous</u>	
	Ammonia Smokes	201
	Arsenic chloride	208
	Chlorides and Oxychlorides	208
	Chlorates	209
	Nitrate mixtures	209
	Fumyl	211

<u>X</u>	Use of Smoke	212
	Smoke Tactics	212
	Smoke Producing Substances Available	218
	Quantities required to form a Screen or Barrage	221

CWM 12: Smoke Filters, Clarence J. West, Jun 1919

<u>I</u>	<u>Introduction</u>	1
<u>II</u>	<u>The Application of Smoke Filters to the Army Canister</u>	7
	Standard Box Respirator Canister	7
	Smoke Protection by Cotton Pads	8
	Fine Smoke Filters	9
	Cover Cartridges	9
	Early Filters	10
	Doughnut Filters	10
	Molded Pulp Filter	10
	Results of Development	12
	Molded Pulp Flat Plate Filters	12
	Flat Plate Felt Filter	13
	Flat Type Paper Filter	14
	Accordion Filter	15
	Accordion Filter Canister	16
	1919 Canister	17
	Wrapped 1919 Canister	18
	Sucked-on Filter	19
	Sucked-on Filter Machine	20
	Future of Sucked-on Filter	20
	Conclusion	21
<u>III</u>	<u>The Application of a Smoke Filter to the Navy Canister</u>	22
	The Application of a Helmet	22
<u>IV</u>	<u>Smoke Filter Box Canister and Valve Die Casting</u>	24a
	Canister Design	24a
	Construction of Smoke Filter	25
	Free Area	27
	Resistance of Canister and Filter	27
	Valve Die Casting	28
	Mechanical Mounting of the Paper	29
<u>V</u>	<u>Clark – Raisig Smoke Filter Cartridge</u>	31a
	Description of Cartridge	32
	Paper used	33
	Test Results	33
	Discussion	37
<u>VI</u>	<u>Plaited Internal Filter</u>	37a
<u>VII</u>	<u>Moulded Wood Pulp Smoke Filter</u>	41
	Methods of Moulding Block Material	43
	Bottom Gravity Drainage	43
	Side Gravity Drainage	51
	Compression	52
	Filters and Tests	54
<u>VIII</u>	<u>Development of the Accordion Filter Canister</u>	59
	Filter Construction	

	Block Felts	59
	Sheet Felts Glued	60
	Metal Edges	61
	Paper Filter	63
	Embossed Spacer	64
	Filter Paper Development	65
	U. Section Spacer	66
	Embossed and Glued Discs	66
	Success of Filter Construction	67
	Possible Improvements in Canister	68
<u>IX</u>	<u>Method of Applying Wrapped Paper Filters to Logan Canister</u>	69
<u>X</u>	<u>The "Sucked-on" Filter</u>	72
	Development of Filter	74
	Equipment of Plant	74
	Testing Methods	81
	Results	82
	Optimum Conditions for Making the Filter	99
	Specifications	99
	Machine for Large Scale Production	104
	<u>Appendix</u>	
	Description of German Smoke Filters	113

CWM 15: Lachrymators, Part II, Acrolein, Clarence J. West, 10 Sep 1918

Introduction	1
Preparation	2
Glycerol	2
Trimethylene glycol	25
Ethylene carbon monoxide	27
Acetylene, Carbon monoxide and hydrogen	27
Acetylene and Methyl alcohol	28
Acetylene and Formaldehyde	28
Properties	30
Polymerization	30
Disacryl	30
Gum	34
Stabilization	37
Analysis	41
Testing efficiency of canisters	46
Absorption	49
Protection	49
Physiology	50
Sensitiveness of individuals	52
Pathology	53
Treatment	54
Tactical Use	54
Shell filling	55
Bibliography	56

CWM 15: Lachrymators, Part III, Brombenzyl Cyanide, Clarence J. West, 14 Sep 1918

Preparation	1
Manufacture	3
Properties	
Benzyl cyanide	27
Bromobenzyl cyanide	28
Determination in air mixtures	31
Testing efficiency of canisters	37
Protection	39
Cleaning of objects contaminated with	
Bromobenzyl cyanide	42
Physiological	
Benzyl cyanide	43
Bromobenzyl cyanide	
Transformation table	44
Toxicity	45
Sensitiveness	46
Effect on horse	47
Persistence	48
Tactical Use	48
Detonation	49
Grenades	55
Bromxylyl cyanide	
Preparation	57
Toxicity	58
Sensitivity	59
Bibliography	

CWM 15: Lachrymators, Part V, Halogenated Esters, Clarence J. West, 30 Oct 1918

I	<u>Ethyl Bromoacetate</u>	
	Preparation	1
	Properties	1
	Analysis	2
	Toxicity	3
	Symptoms	3
II	<u>Ethyl Iodoacetate</u>	
	Preparation	5
	Properties	8
	Action on Metals	9
	Transformation Table	11
	Toxicity	11
	Sensitivity	13
	Protection	16
	Symptoms and Treatment of Ethyl	
	Iodoacetate Poisoning	17
	Use in Shell	20
	Travel of Vapors	27
	Comparative Neutralizing Effects and	
	Over-Surface Persistency	29
	Mixtures of AC and SK	31
	Sensitivity	32

CWM 15: Lachrymators, Part VI, Aromatic Halides, Clarence J. West, Nov 1918

I	<u>Benzyl Bromide</u>	
	Preparation	1
	Properties	2
	Determination	4
	Testing Efficiency of Canisters	6
	Physiology	9
	Absorption	11
	Permeability of Fabrics	11
	Protection	11
	Storage	13
	Tactical Use	14
II	<u>Benzyl Chloride</u>	
	Preparation	16
	Manufacture	19
	Properties	20
	Corrosion Tests	23
	Analysis in Air	26
	Physiological	26
III	<u>Benzyl Iodide</u>	
	Preparation	28
	Properties	29
	Lachrymatory Power	30
	Fraissite	30
IV	<u>Derivatives of the Benzyl Halides</u>	
	P-Bromobenzyl bromide	31
	P-Chlorobenzyl bromide	32
	Preparation	32
	Properties	33
	Physiology	34
	2,4 Dichlorobenzyl bromide	35
	Properties	35
	Action on Metals	35
	Determination in Air	36
	Lachrymatory Power	38
	Chlorobenzyl Chloride	39
	Chlorobenzyl Iodide	39
	Chloro-O-nitrobenzyl chloride	40
	M-Iodobenzyl bromide	40
	P-Nitrobenzyl bromide	40
	O-Nitrobenzyl bromide	40
	O-Nitrobenzyl chloride	40
	P-Nitrobenzyl chloride	41
	Cedenite	41
	Dinitrobenzyl chloride	41
	Comparison	42
V	<u>Xylyl Bromide</u>	
	O-Xylyl bromide	43
	M-Xylyl bromide	44
	P-Xylyl bromide	44
	Xylyl bromide	48
	Action on Various Metals	48

Corrosion Tests	51
Mixtures	54
Absorption by Kieselguhr	55
Analysis	55
Absorption	57
Permeability Tests	58
Removal from Linoleum and Wood	59
Shells	60
Fire Procedure with T- and K-Shell	62
Shell Linings	64
Navy Shells	66
Toxic Smoke	66
VI Xylyl Bromide and other Derivatives	
Xylyl iodide	67
Xylylene chloride	67
M-Xylylene dibromide	67
Chloro-M-Xylylene bromide	68

CWM 15: Lachrymators, Part VIII, Miscellaneous, Clarence J. West [2 copies]

Acetonitrile	2
Allyl amine	4
Allyl cyanide	6
Allyl isothiocyanate	8
Amyl isothiocyanate	11
Benzoyl fluoride	12
Bromoacetyl bromide	13
Bromoacetaldehyde	14
Bromoacetonitrile	15
Bromophenol	16
Bromophenyl bromoacetonitrile	17
Capsicum	18
Chloroacetonitrile	31
Chloroacetyl fluoride	32
Chloroethyl chloroformate	33
2-Chloroethyl sulfide	34
B-Chloroethyl thiocyanate	35
2-Chloromethyl butyl ether	37
Chloromethyl chloroformate	40
4-Chlorophenyl bromoacetonitrile	41
Chloropicrin	42
Crotonic aldehyde	43
Cyanogen Compounds	44
Dibromomethyl ether	45
Dichlorodinitromethane	48
A,A-Dichloroethyl ether	49
s-Dichloromethyl ether	52
Ethyl chlorosulfonate	55
Iodoacetaldehyde	57
Iodoacetonitrile	58
Methyl chloroformate	59
Methyl chlorosulfonate	60
Mustard oils	64

Naphthalene tetrachloride	65
Perchloromethyl mercaptan	66
Phenylcarbylamine chloride	67
Phenylisothiocyanate	74
Thionyl aniline	77
Thiophosgene	78
Trichloroacetyl chloride	79
Trichloroacetyl fluoride	80
Trichloroacetonitrile	81
Trichloronitroethylene	85

CWM 15: Analytical Methods, Chloropicrin - Mustard Gas, L. L. Satler and Clarence J. West, Apr 1919 [new series]

I	<u>Chloropicrin</u>	
	Properties	1
	Detection	2
	Decomposition by Sodium sulfite	8
	Decompositions by Peroxides	12
	Decomposition by Na_2O_2 and determination of chlorides	12
	Decomposition by Na_2O_2 and determination of nitrates	18
	Decomposition by H_2O_2 and determination of chlorides or nitrates	19
	Colorimetric Determination	19
	Phenolphthalin method	20
	Beta-Naphthol method	21
	Decomposition by Sodium ethylate and determination of nitrites	23
	Phenoldisulfonic acid method	24
	Combustion method	26
	Decomposition by Sodium ethylate and titration of Chlorine	31
	Method of Reduction to Methylamine	33
	Physiological determination	35
	Determination of Chloropicrin in Gas mixtures	39
	Chloropicrin and Phosgene	39
	Chloropicrin and Cyanogen chloride	43
	Chloropicrin, Chlorine, and Hydrogen chloride	45
	Chloropicrin, Stannic chloride, and Phosgene	46
	Chloropicrin and Silicon tetrachloride	47
	Chloropicrin and Mustard gas	48
	Chloropicrin and Superpalite	48
	Chloropicrin and Chloracetophenone	49
	Chloropicrin and Sulfur dioxide	50
	Chloropicrin and Ammonia	51
	Chloropicrin and Hydrocyanic acid	51
	Conversion Tables	52
II	<u>Mustard Gas</u>	
	Properties	73
	Detection of Mustard gas	80

Limit of Detection by Odor	82
A-Naphthol Method	83
B-Naphthol Method	84
Congo Red Method (Hydrochloric Acid Reaction)	88
Reduction of Selenious acid	91
Selenious acid field detector	95
Sodium iodide Method (Grignard)	97
Sodium Platinic-iodine Method	101
Permanganate Method	102
Ethylene disulfide Odor Detection	103
Anisole Test	103
Aldehyde Test	104
Iodine chloride Test	105
Iodine pentoxyde Test	106
Iodic acid Test	106
Iodic acid Field Detector	108
Starch Iodide Detector	109
Combustion-Iodate Detector	109
Sulfurous Acid Iodine Method	110
Combustion – Silver Nitrate Method	111
Hydrolysis – Silver Nitrate Method	111
Hydrolysis – Detection by Benedict's Reagent	111
Ricinoleic Acid, Emulsion Test	113
Turkey Red Oil plus AgNO ₃	117
Sulfur Reactions for Detection	118
Comparison	119
German Field Detector	128
Paint Detector for Liquid Mustard Gas	129
Lantern Test Apparatus (Copper halogen reaction)	141
Field Detector Apparatus (Hydrogen Sulfide reaction)	155
Organism Detectors	161
Detection of Mustard Gas Products in Urine	166
Analysis of Mustard Gas	168
Alcoholic Solutions	169
Acetic Acid Solutions	174
Aqueous Sodium Peroxide Solution	175
Hydrolysis in Alcohol & Hot Water	178
Sulfur by Iodine Addition Reaction	179
Iodine Oxidation of Products Decomposed by Heat	180
Application of B-Naphthol Reaction	181
Concentrated Sulfuric Acid Decomposition	182
In Presence of Phosgene	183
By Reduction of Selenious Acid Reagent	189
Volumetric Analysis	193
Nephelometric Analysis	Appendix

CWM 16: Analytical Methods, Part II, Arsenic Derivatives, Miscellaneous Organic Analysis, L. T. Satler and Clarence J. West, Apr 1919

<u>I</u>	<u>Arsenic Derivatives:</u>	
	Arsine	1
	Properties	1
	Detection	1
	Analysis	3
	By iodine oxidation	3
	In presence of acetylene	10
	By chlorimetric method	11
	Arsenic Trifluoride	
	Properties	16
	Analysis	16
	Decomposition from moisture	17
	Arsenic Trichloride	
	Properties	21
	Analysis	21
	Of mixtures of arsenic trichloride, phenyl-dichlorarsine, diphenylchlorarsine, and triphenylchlorarsine	22
	D.M.	
	Properties	25
	Detection	26
	Analysis	26
	Diphenylchlorarsine	
	Properties	32
	Detection	32
	Analysis	
	Kjeldahl oxidation, and reduction with SO ₂	34
	Gutzeit application	37
	Modified Gutzeit method	38
	Improvements to modified Gutzeit method	42
	Reagents for Gutzeit method	42
	Gutzeit application to evacuated samples	48
	Direct iodine oxidation method	49
	Acetic acid method and iodine titration	50
	Arsenious chloride method for large amounts	58
	Electrical precipitation	58
	Determination of solid particles in air mixtures	60
	Diphenylcyanarsine	
	Properties	65
	Detection	
	Earth samples	65
	Water samples	66
	Analysis	66
	Dimethylarsenic Cyanide (Cacodyl Cyanide)	
	Properties	68
	Detection	68
	Analysis	69
	Methyldichlorarsine	
	Properties	70
	Detection	70
	Analysis	

I		
	Iodine oxidation of the arsenite	71
	Direct iodine addition in acetic acid	71
	Ethyldichloroarsine	
	Properties	78
	Detection	78
	Analysis	80
	Phenyldichloroarsine	
	Properties	81
	Detection	81
	Analysis	
	Volhard's method for chlorine content	82
	Iodine oxidation of the arsenite	83
	Iodine titration in acetic acid	83
	Gutzzeit application	85
	Mustard-1	
	Properties	86
	Detection	87
	Analysis	
	Chlorine content	87
	Arsenic content	88
	Air mixture of M-1	89
	Mixture of M-1 and mustard gas	90
	Mixture of M-1 and M-2	92
	Mixture of M-1 and AsCl ₃	92
	Mustard-1	93
	Mustard-2	95
	Mixture of mustard 1 and 2	96
II	<u>Analysis of Halogen Compounds</u>	
	Introduction	103
	Solvents for Compounds	106
	Alcoholic sodium hydroxide	106
	Aqueous sodium hydroxide	106
	Alcoholic sodium sulfite	107
	Alcoholic silver nitrate solution	107
	Modification of the Mohr method	107
	Modification of the Volhard method	110
	Importance of chlorine free reagents	112
	Standardization of the silver nitrate solution	112
	Calculations	113
III	<u>Halogen Compounds</u>	
	Liquid Ammonia Sodium Method for Halogen in Organic Compounds	116
	Use of Potassium Iodide and Potassium Iodate in Solution as a Reagent for Chlorine Products	121
IV	<u>Nitrogen</u>	
	Determination of Nitrogen in Nitronaphthalenes	133
	Dumas method	134
	Kjeldahl-Gunning-Jodlbauer method	143
V	<u>Superpalite</u>	
	Detection by Organism	149
	Qualitative Test	151
	Analysis	155
	Analysis of Mixtures	159
VI	<u>Chloroacetophenone</u>	

	Detection	162
	Analysis	162
<u>VII</u>	<u>Miscellaneous</u>	
	Ethyl Chloride	167
	Carbon Tetrachloride	169

CWM 17: Organic Arsenic Derivatives, Part I, Pages 1-200, Clarence J. West, 25 Nov 1918 [old series]

<u>I</u>	<u>Methyldibromoarsine</u>	1
<u>II</u>	<u>Methyldichloroarsine</u>	6
<u>III</u>	<u>Dimethylbromoarsine</u>	46
<u>IV</u>	<u>Dimethylchloroarsine</u>	48
<u>V</u>	<u>Dimethylarsenic cyanide</u>	52
<u>VI</u>	<u>Cacodyl oxide</u>	60
<u>VII</u>	<u>Methyldiidoarsine</u>	63
<u>VIII</u>	<u>Ethylarsine</u>	64
<u>IX</u>	<u>Ethyldichloroarsine</u>	69
<u>X</u>	<u>Ethyldiidoarsine</u>	89
<u>XI</u>	<u>Ethoxydichloroarsine</u>	90
<u>XII</u>	<u>B-Chloroethyl dichloroarsine</u>	91
<u>XIII</u>	<u>Butyl dichloroarsine</u>	92
<u>XIV</u>	<u>Diisoamylchloroarsine</u>	93
<u>XV</u>	<u>B-Chlorovinylethylchloroarsine</u>	94
<u>XVI</u>	<u>Phenyldimethylarsine</u>	95
<u>XVII</u>	<u>Phenylmethylbromoarsine</u>	96
<u>XVIII</u>	<u>Phenyldichloroarsine</u>	97
<u>XIX</u>	<u>Phenyldibromoarsine</u>	119
<u>XX</u>	<u>Diphenylchloroarsine</u>	120
<u>XXI</u>	<u>Diphenylfluoroarsine</u>	282
<u>XXII</u>	<u>Diphenylbromoarsine</u>	283
<u>XXIIa</u>	<u>Diphenyliodoarsine</u>	285
<u>XXIII</u>	<u>Diphenylcyanoarsine</u>	286
<u>XXIV</u>	<u>B-Chlorovinylphenylchloroarsine</u>	311
<u>XXV</u>	<u>Tolyl derivatives of arsenic</u>	312
<u>XXVI</u>	<u>Anisyldichloroarsine</u>	314
<u>XXVII</u>	<u>Iminophenyl-p-naphthylchloroarsine</u>	316
<u>XXVIII</u>	<u>D.M. 'As-Chlorophenarsazine'</u>	317
<u>XXVIIIa</u>	<u>Cyano-D.M. 'As-Cyanophenarsazine'</u>	352
<u>XXIX</u>	<u>As-Chlorophenoxyarsine</u>	353
<u>XXX</u>	<u>Diphenylarsine oxide</u>	354
<u>XXXI</u>	<u>Triphenylarsine dichloride</u>	356
	Bibliography	
	Index	

CWM 17: Supplement, Bibliography of Arsenic Compounds, Helen B. Goodhue, 25 Nov 1918 [old series]

CWM 17: Analytical Methods, Part III, Clarence J. West, Apr 1919 [2 copies]

<u>I</u>	<u>Cyanogen</u>	
	Determination by Iodometric titration	1
<u>II</u>	<u>Hydrocyanic Acid</u>	
	Tests	6

	Analysis	
	Iodine method	15
	Silver Nitrate method	16
	Nickel sulfate method	17
	Determination of HCN and (CN) ₂ in air	19
<u>III</u>	<u>Cyanogen Chloride</u>	
	Qualitative tests	25
	Analysis	31
	Air samples	33
	Comparison of methods	44
	Mixtures	
	Chloropicrin	52
	Phosgene	56
<u>IV</u>	<u>Phosgene</u>	
	Test paper	64
	Detectors	68
	Analysis	71
	Air mixtures	72
	Fractionation	76
	Conversion Tables	100
	Mixtures	
	Chlorine	
	Detection	107
	Fractionation	110
	Analysis	114
	Cyanogen chloride	118
	Sulfur dioxide	119
<u>V</u>	<u>Fluorides</u>	
	Lead and Sodium fluoride	120
<u>VI</u>	<u>Carbon Monoxide</u>	
	Calometric determination	122
<u>VII</u>	<u>Air in Submarine</u>	
	Portable apparatus	144
<u>VIII</u>	<u>Sodium Permanganate</u>	
	Sampling	151
	Total oxidizing power	152
	Sodium manganate	156
	Manganese	159
	Carbonate & free alkali	161
	Total alkali	163
	Total chloride	165
	Chlorate	167
	Sulfate	168
	Calculations	169
<u>IX</u>	<u>Soda Lime</u>	
	Hydrated lime	172
	Sodium permanganate	178
	Insoluble residue	179
	Sulfuric anhydride	180
	Magnesia	181
<u>X</u>	<u>Miscellaneous</u>	
	Total alkali in permanganate solutions	184
	Ammonia reduction method	192
	Barium manganate	196

Iodic anhydride	201
Hoolomite from canisters	205
Manganese dioxide	208

CWM 18: Lachrymators, Part VIII, Miscellaneous, Clarence J. West [same as CWM 15, Part VIII]

Acetonitrile	2
Allyl amine	4
Allyl cyanide	6
Allyl isothiocyanate	8
Amyl isothiocyanate	11
Benzoyl fluoride	12
Bromoacetyl bromide	13
Bromoacetaldehyde	14
Bromoacetonitrile	15
Bromophenol	16
Bromophenyl bromoacetonitrile	17
Capsicum	18
Chloroacetonitrile	31
Chloroacetyl fluoride	32
Chloroethyl chloroformate	33
2-Chloroethyl sulfide	34
B-Chloroethyl thiocyanate	35
2-Chloromethyl butyl ether	37
1-Chloromethyl A-chloroethyl ether	38
Chloromethyl chloroformate	40
4-Chlorophenyl bromoacetonitrile	41
Chloropicrin	42
Crotonic aldehyde	43
Cyanogen compounds	44
Dibromomethyl ether	45
Dichlorodinitromethane	48
A,A - Dichloroethyl ether	49
s-Dichloromethyl ether	52
Ethyl chlorosulfonate	55
Iodoacetaldehyde	57
Iodoacetonitrile	58
Methyl chloroformate	59
Methyl chlorosulfonate	60
Mustard oils	64
Naphthalene tetrachloride	65
Perchloromethyl mercaptan	66
Phenylcarbylamine chloride	67
Phenylisothiocyanate	74
Thionyl aniline	77
Thiophosgene	78
Trichloroacetyl chloride	79
Trichloroacetyl fluoride	80
Trichloroacetonitrile	81
Trichloronitroethylene	85

CWM 19: Chloropicrin, Part I, Clarence J. West, May 1919 [2 copies]

Introduction	1
Historical	1
Laboratory Preparation	3
Aromatic Compounds	3
Aliphatic Compounds	9
Manufacture	13
Properties	23
Action on Metals	34
Volatility	37
Mixtures	46
Detection	57
Analysis	63
Mixtures	95
Government Method	108
Determination of Water	113
Testing Absorbents	115
Testing Canisters	143
Mixture with Cyanogen Chloride	160
Man Test	163
Permeability of Fabrics	165

CWM 19: Chloropicrin, Part II, Clarence J. West, May 1919

Physiology	1
Toxicity	4
Man Test	10
Pathology	13
Treatment	29
Protection	34
Absorption	
Charcoal	37
Rubber	65
Permeability	69
Canister efficiency	75
Mixtures	88
Tactical Use	
Shell	97
Gas Waves	102
Decomposition in Shell	106
Livens Projectile	115
Hard Grenade	122
Lachrymator	127
Persistency	128

CWM 20: Inorganic Arsenic Derivatives, Part I, Arsine, Clarence J. West, May 1919

I	<u>Arsine</u>
Preparation	1
Purification	8
Liquefaction	8
Manufacture	10

Physical Properties	14
Phosgene mixture	17
Cyanogen Chloride Mixture	20
Chemical Properties	21
Action on Metals	29
Action of Various Solutions	30
Volume Changes of Arsine during Decomposition	32
Arsine Hydrate	33
Removal of Moisture	37
Detection	38
Analysis	39
Efficiency of Absorbents	55
Efficiency of Canisters	62
Physiological Properties	78
Effect on Blood	82
Pathology	93
Protection	97
Tactical Use	100

CWM 20: Inorganic Arsenic Derivatives, Part 2, Arsenides, Halides, Oxide, Clarence J. West, May 1919

<u>II</u>	<u>Metallic Arsenides</u>	
	Aluminum Arsenide	106
	Calcium Arsenide	108
	Iron Arsenide	122
	Magnesium Arsenide	123
	Manufacture	125
	Destruction	129
	Reactions	132
	Hydrolysis	136
	Decomposition	140
	Analysis	152
	Physiological	153
	Use as toxic smoke	156
	Use in shell	157
	Persistency	173
	Sodium Arsenide	177
	Zinc Arsenide	178
	Mixed Arsenides	181
<u>III</u>	<u>Arsenic Trichloride</u>	
	Preparation	184
	Manufacture	185
	Chemical Properties	195
	Analysis	199
	Physiological	202
	Skin irritant	203
	Mustard Gas Mixture	207
	Use in Cloud Attack	210
	Use in Gas Shell	210
	Protection	211
<u>IV</u>	<u>Arsenic Tribromide</u>	
	Preparation	215
	Properties	216

	Physiology	217
	Use as Toxic Smoke	217
	Cyanogen Bromide Mixture	219
<u>V</u>	<u>Arsenic Trifluoride</u>	
	Preparation	222
	Manufacture	223
	Properties	226
	Analysis	228
	Decomposition	229
	Physiology	231
	Absorption by Canister Materials	235
<u>VI</u>	<u>Arsenic Trioxide</u>	
	Preparation	245
	Properties	247
	Physiology	249
	Treatment	250
	Suggested Tactical Use	250
	Use as Toxic Smoke	253

CWM 21: Organic Arsine Derivatives, Part I, Aliphatic Compounds, Clarence J. West, Apr 1919 [2 copies]

<u>I</u>	<u>Trimethylarsine</u>	1
<u>II</u>	<u>Methyldibromoarsine</u>	
	Preparation	4
	Properties	5
	Toxicity	6
	Skin irritant	8
	Protection	10
<u>III</u>	<u>Methyldichloroarsine</u>	
	Preparation	13
	Manufacture	21
	Properties	33
	Qualitative Test	39
	Analysis	40
	Testing canisters	46
	Absorption	48
	Permeability	52
	Toxicity	55
	Skin irritant	60
	Pathology	83
	Toxic smoke	88
	Toxic candle	89
	Toxic gas cylinder	89
	Use in gas shell	90
	Persistency in soil	90
<u>IV</u>	<u>Methyldiidoarsine</u>	95
<u>V</u>	<u>Methyldimethoxyarsine</u>	96
<u>VI</u>	<u>Methyldiethoxyarsine</u>	97
<u>VII</u>	<u>Methyldiphenoxyarsine</u>	99
<u>VIII</u>	<u>Dimethylbromoarsine</u>	100
<u>IX</u>	<u>Dimethylchloroarsine</u>	102
<u>X</u>	<u>Dimethylcyanoarsine</u>	107
<u>XI</u>	<u>Cacodyl Oxide</u>	115

<u>XII</u>	<u>Trimethyl Thioarsenite</u>	118
<u>XIII</u>	<u>Ethylarsine</u>	121
<u>XIV</u>	<u>Ethyldichloroarsine</u>	
	Preparation	126
	Properties	127
	Tests, qualitative	127
	Analysis	129
	Physiology	131
	Toxicity	133
	Skin irritant	140
	Pathology	145
	Protection	147
	Persistency	149
<u>XV</u>	<u>Ethyldiidoarsine</u>	155
<u>XVI</u>	<u>Ethoxydichloroarsine</u>	156
<u>XVII</u>	<u>Ethyldethoxyarsine</u>	157
<u>XVIII</u>	<u>Ethyldimethoxyarsine</u>	159
<u>XIX</u>	<u>Ethyldiphenoxoarsine</u>	160
<u>XX</u>	<u>Ethyldianilinoarsine</u>	161
<u>XXI</u>	<u>B-Chloroethyldichloroarsine</u>	162
<u>XXII</u>	<u>Ethylarsine Sulfide</u>	163
<u>XXIII</u>	<u>Ethylarsine Disulfide</u>	165
<u>XXIV</u>	<u>Butyl Dichloroarsine</u>	167
<u>XXV</u>	<u>Diisoamyl Chloroarsine</u>	169
<u>XXVI</u>	<u>B-Chlorovinylethylchloroarsine</u>	170
<u>XXVII</u>	<u>Ethylarsine oxide</u>	172

CWM 21: Organic Arsenic Derivatives, Part II, Aromatic Compounds, Clarence J. West, Apr 1919 [2 copies]

<u>I</u>	<u>Phenyldimethylarsine</u>	
	Preparation and Properties	1
	Physiological Properties	1
	Protection	2
<u>II</u>	<u>Triphenylarsine</u>	
	Preparation	2
	Manufacture	6
	Properties	25
	Analysis	27
	Physiological Properties	28
	Toxic Smoke	28
<u>III</u>	<u>Phenylmethylarsenious Bromide</u>	31
<u>IV</u>	<u>Phenyldibromoarsine</u>	32
<u>V</u>	<u>Phenyldichloroarsine</u>	
	Preparation	33
	Properties	36
	Analysis	39
	Efficiency of Canisters	42
	Physiological Properties	45
	Protection	63
	Toxic Smoke	66
<u>VI</u>	<u>Sternite</u>	72
<u>VII</u>	<u>Phenylethoxychloroarsine</u>	76
<u>VIII</u>	<u>B-Chlorovinyl Phenylchloroarsine</u>	77

<u>IX</u>	<u>p-Chlorophenyldichloroarsine</u>	78
<u>X</u>	<u>Phenyldifluoroarsine</u>	79
<u>XI</u>	<u>Dichlorotolylarsine</u>	80
<u>XII</u>	<u>Phenylarsenious Oxide</u>	81
<u>XIII</u>	<u>Phenylarsenic Acid</u>	82
<u>XIV</u>	<u>Arsanilic Acid</u>	87
<u>XV</u>	<u>p-Aminophenyl Arsenious Oxide</u>	89
<u>XVI</u>	<u>p-Aminophenyl Dichloroarsine</u>	91
<u>XVII</u>	<u>Diphenylbromoarsine</u>	92
<u>XVIII</u>	<u>Diphenylcyanoarsine</u>	
	Preparation	94
	Properties	96
	Detection	98
	Analysis	98
	Canister testing	101
	Physiological Properties	102
	Protection	118
	Use in shell	120
	Toxic smoke	120
<u>XIX</u>	<u>Diphenylethoxyarsine</u>	124
<u>XX</u>	<u>Diphenylfluoroarsine</u>	125
<u>XXI</u>	<u>Diphenyliodoarsine</u>	126
<u>XXII</u>	<u>Diphenylphenoxyarsine</u>	127
<u>XXIII</u>	<u>Diphenylsulfocyanoarsine</u>	130
<u>XXIV</u>	<u>Diphenylarsenious oxide</u>	131
<u>XXV</u>	<u>Diphenylarsenious Sulfide</u>	132
<u>XXVI</u>	<u>Tolyl Arsenic Compounds</u>	133
<u>XXVII</u>	<u>Anisylchloroarsine</u>	135
<u>XXVIII</u>	<u>Triphenylarsinedichloride</u>	
	Preparation	138
	Properties	138
	Physiological Properties	140
	Toxic Smoke	140
<u>XXIX</u>	<u>Phosgene Triphenylarsine</u>	147

CWM 21: Organic Arsenic Derivatives, Part III, Diphenylchloroarsine, Clarence J. West, Apr 1919

Introduction	1
Preparation	2
Manufacture	9
Properties	27
Detection	39
Analysis	40
Determination in Air Mixtures	82
Determination in Gas Chamber Concentrations	89
Ratio of Particles to Vapor in Clouds	99
Methods of Establishing Concentrations	107
Testing Efficiency of Canisters	130
Testing Fabrics	143
Testing Smoke Filters	146

CWM 21: Organic Arsenic Derivatives, Part IV, Diphenylchloroarsine, Clarence J. West, Apr 1919 [marked Part II, 2 copies]

“Effective State” of Concentration	164
Penetration of Canisters	169
Selection of Particles in Penetration of the Standard	
Filter by Smokes	172
Nature of the “Break” with Diphenylchloroarsine	175
Physiological Properties	182
Protection	193
Toxic Smoke	209
Tactical Use	217
Toxic Smoke Shell	233
Use in Stokes Bombs	239
Use with Ethyl Carbazole	241
Toxic Candle	246
Use in Oleum Smoke	250
Solution in Chloroacetophenone	251
Use of Diphenylchloroarsine	251
Precautionary Measures	254
Diphenylchloroarsine – Phosgene Mixtures	257
Mobile Gas Cylinder, use in	265
Use in Gas Shell	268
Diphenylchloroarsine – Carbon Monoxide Mixture	274

CWM 21: Organic Arsenic Derivatives, Part V, DM and Related Compounds, Clarence J. West, Apr 1919 [2 copies]

I	<u>D.M.:</u>	
	Preparation	1
	Manufacture	7
	Properties	15
	Analysis	21
	Efficiency of filters	29
	Toxicity	35
	Irritant Properties	37
	Skin irritant	38
	Shrapnel shell	40
	High explosive shell	41
	Toxic smoke	44
	D.M. candle	58
	Hand grenade	67
	Stokes Mortar Shell	68
	Penetration	70
II	<u>D.M. – HCl:</u>	74
III	<u>Acetyl D.M.</u>	75
IV	<u>Benzoyl D.M.</u>	76
V	<u>Benzyl D.M.</u>	77
VI	<u>As-Bromophenarazine</u>	
	Preparation	78
	Irritant Properties	78
	Toxicity	80
	Toxic Smoke	80
VII	<u>As-Cyanophenarsazine</u>	82

	Preparation	82
	Toxicity	83
	Toxic Smoke	83
<u>VIII</u>	<u>As-Iodophenarsazine</u>	84
<u>IX</u>	<u>As-Thiocyanophenarsazine</u>	86
<u>X</u>	<u>D.M. oxide</u>	88
<u>XI</u>	<u>Various condensation products</u>	89
<u>XII</u>	<u>Iminophenyl-B-naphthyl chloroarsine</u>	90
<u>XIII</u>	<u>Thiodiphenylamine chloroarsine</u>	91
<u>XIV</u>	<u>As-chlorophenoxyarsine</u>	92

CWM 22: Phosgene, Part I, Clarence J. West, May 1919

Introduction	1
Formation and Preparation	2
Manufacture	11
The Removal of Chlorine from Phosgene	35
Physical Properties	46
Absorption by Solid Material	53
Chemical Properties	57
Hydrolysis	60
Mixtures	65
Corrosion Tests	88
Detection	103
Tests of Purity	108
Analysis	110
Analysis of Mixtures	125
Efficiency of Absorbents	154
Efficiency of Canisters	175

CWM 22: Phosgene, Part II, Clarence J. West, Jun 1919

Absorption	
Charcoal	1
Soda Lime	18
Peroxide Granules	21
Copper Oxide	22
Rubber	36
Protection	39
Canister testing	41
Permeability of Fabrics	73
Use in Shell	79
Wave Attacks	85
Gas Shell	102
Projectors	116
Possible Use as Toxic Smoke	133
Firing Trials	135
Mixture with Chlorine	138
Mixture with Cyanogen Chloride	140
Military Value	141

CWM 22: Phosgene, Part III, Clarence J. West, Jun 1919

Physiological Properties	1
Toxicity	5
Toxicity of Mixtures	11
Man Tests	18
Action on Blood	22
Pathology	37
Bulmonary Edema	63
Treatment	74

CWM 23: Cyanogen and Hydrocyanic Acid, Clarence J. West, May 1919

I	<u>Cyanogen</u>	
	Preparation	1
	Properties	4
	Analysis	7
	Physiology	11
	Protection	14
	Military Value	15
II	<u>Hydrocyanic Acid</u>	
	Introduction	16
	Natural Occurrence	19
	Preparation	19
	Manufacture	26
	Constitution	39
	Properties	39
	Tests	57
	Analysis	65
	Cyanogen and Hydrocyanic Acid	70
	Testing Absorbents	76
	Testing Canisters	83
	Physiology	90
	Treatment of Poisoning	101
	Absorption	102
	Efficiency of Absorbents	106
	Efficiency of Canisters	115
	Action on Absorbents	132
	Firing Trials	144
III	<u>Vincennite</u>	
	Introduction	146
	Manufacture	147
	Properties	148
	Stability	149
	Use in Artillery Shell	151
	Comparison with Jellite	155
	Protection	156
IV	<u>Other Mixtures</u>	
	Jellite	159
	Acetylene Tetrachloride	162
	Ether	162
	Carbon Tetrachloride	162
	Chloropicrin	162

	Arsenic Trichloride	163
	Ethyl Iodoacetate	163
<u>V</u>	<u>Kendallite</u>	
	Preparation	169
	Sesquihydrochloride	171
	Test	173
	Firing Trials	174
<u>VI</u>	<u>Metallic Cyanides</u>	
	Ammonium Cyanide	177
	Sodium Cyanide	177

CWM 24: Cyanogen Derivatives, Chloride, Bromide, Iodide Sulfide, Part I, Clarence J. West, Apr 1919

<u>I</u>	<u>Cyanogen Chloride</u>	
	Preparation	1
	Manufacture	18
	Properties	38
	Mixture	54
	Tests	55
	Analysis	60
	Analysis of Mixtures	78
	Tube Tests for Absorbents	92
	Accelerated Tube Test	99
	Testing Efficiency of Canisters	104
	Relation of Canister and Tube Tests	110
	Continuous and Intermittent Machine Tests	113
	Physiological Properties	114
	Toxicity	114
	Man Tests	122
	Field Tests	123
	Pathology	124
	Absorption	130
	Temperature	144
	Moisture	151

CWM 24: Cyanogen Derivatives, Chloride, Bromide, Iodide Sulfide, Part II, Clarence J. West, Apr 1919 [2 copies]

<u>I</u>	<u>Cyanogen Chloride (cont'd)</u>	
	Protection	153
	Concentration	160
	Temperature	163
	Mixtures	164
	Permeability of Fabrics	176
	Use in Gas Shell	179
	Use in Livens Projectiles	181
	Effect of Capsaicin	192
	Vitryte	193
<u>II</u>	<u>Cyanuric Chloride</u>	
	Preparation	197
	Properties	198
	Toxicity	199
<u>III</u>	<u>Cyanogen Bromide</u>	

	Preparation	202
	Manufacture	203
	Properties	212
	Qualitative Test	217
	Determination	217
	Testing Efficiency of Canisters	218
	Physiology	220
	Toxicity	221
	Man Test	230
	Pathology	230
	Tactical Use	237
	Bomb Pit	237
	Gas Shell	238
	Toxic Smoke	241
	Mixtures	245
	Protection	246
<u>IV</u>	<u>Cyanuric Bromide</u>	
	Preparation and Properties	253
<u>V</u>	<u>Cyanogen Iodide</u>	
	Preparation and Properties	254
<u>VI</u>	<u>Cyanogen Sulfide</u>	
	Preparation and Properties	257
	Toxicity	260
	Toxic Smoke	261
<u>VII</u>	<u>Cyanohydrins</u>	
	Physiology	264

CWM 25: Superpalite and Intermediates, Clarence J. West, Mar 1919 [2 copies]

<u>I</u>	<u>Methyl Formate</u>	1
<u>II</u>	<u>Methyl Chloroformate</u>	10
<u>III</u>	<u>Chloromethyl Chloroformate</u>	34
<u>IV</u>	<u>Dichloromethyl Chloroformate</u>	43
<u>V</u>	<u>Trichloromethyl Chloroformate</u>	45
<u>VI</u>	<u>Superpalite Mixtures</u>	143

Bibliography

Index

CWM 26: Fluorine and Derivatives, Clarence J. West and Austin M. Patterson, Apr 1919 [3 copies]

<u>I</u>	<u>Fluorine</u>	
	Occurrence	1
	History	2
	Formation and Preparation	3
	Physical Properties	24
	Chemical Properties	25
	Reactions	26
	Tests	45
	Analysis	46
	Physiological Effects	48
<u>II</u>	<u>Hydrofluoric Acid</u>	

	Occurrence and Formation	49
	Preparation of the Aqueous Acid	50
	Preparation of the Anhydrous Acid	57
	Manufacture	62
	Properties of the Anhydrous Acid	73
	Properties of the Aqueous Acid	75
	Purification of the Aqueous Acid	76
	Preservation of the Aqueous Acid	77
	Physiological Effects	78
	Protection	79
<u>III</u>	<u>Bromine Fluoride</u>	
	Preparation	85
	Reactions	86
	Physiological Effects	87
<u>IV</u>	<u>Iodine Fluoride</u>	
	Formation and Preparation	88
	Reactions	89
	Military	91
<u>V</u>	<u>Boron Fluoride</u>	
	Formation and Preparation	92
	Inorganic Reactions	95
	Organic Reactions	97
<u>VI</u>	<u>Silicon Tetrafluoride</u>	
	Formation	101
	Reactions	103
<u>VII</u>	<u>Silico Fluoroform</u>	
	Preparation and Properties	105
<u>VIII</u>	<u>Titanium Tetrafluoride</u>	
	Preparation and Properties	107
<u>IX</u>	<u>Stannic Fluoride</u>	
	Preparation and Properties	111
<u>X</u>	<u>Nitrosyl Fluoride</u>	
	Preparation and Properties	113
<u>XI</u>	<u>Nitryl Fluoride</u>	
	Preparation and Properties	114
<u>XII</u>	<u>Phosphorus Trifluoride</u>	
	Formation and Preparation	115
	Reactions	118
	Military Use	120
<u>XIII</u>	<u>Phosphorus Pentafluoride</u>	
	Preparation and Properties	121
<u>XIV</u>	<u>Phosphorus Fluorochloride</u>	
	Preparation and Properties	124
<u>XV</u>	<u>Phosphorus Fluorobromide</u>	
	Preparation and Properties	126
<u>XVI</u>	<u>Phosphorus Oxyfluoride</u>	
	Preparation and Properties	127
<u>XVII</u>	<u>Phosphorus Sulfofluoride</u>	
	Preparation and Properties	129
<u>XVIII</u>	<u>Arsenic Trifluoride</u>	
	Formation and Preparation	132
	Manufacture	133
	Reactions	136
	Preservation	138

	Analysis	138
	Physiological Effects	139
	Tactical Use	141
	Absorption Tests	141
<u>XIX</u>	<u>Arsenic Pentafluoride</u>	
	Preparation and Properties	150
<u>XX</u>	<u>Antimony Pentafluoride</u>	
	Preparation and Properties	153
<u>XXI</u>	<u>Antimony Fluorochloride</u>	
	Preparation and Properties	156
<u>XXII</u>	<u>Sulfur Hexafluoride</u>	
	Preparation and Properties	157
<u>XXIII</u>	<u>Thionyl Fluoride</u>	
	Preparation and Properties	158
	Analysis and Control in Air Mixtures	160
	Physiological Effects	161
<u>XXIV</u>	<u>Fluorosulfonic Acid</u>	
	Use as Toxic Smoke	163
<u>XXIV-b</u>	<u>Ethyl Fluorosulfonate</u>	
	Preparation and Properties	168
<u>XXV</u>	<u>Bismuth Pentafluoride</u>	
	Preparation and Properties	172
<u>XXVI</u>	<u>Osmium Octafluoride</u>	
	Preparation and Properties	173
<u>XXVII</u>	<u>Lead Tetrafluoride</u>	
	Double Salts	174
<u>XXVIII</u>	<u>Acid Fluorides</u>	
	Lead, Ammonium, etc.	181
<u>XXIX</u>	<u>Organic Fluorine Compounds</u>	
	General	183
	Cacodyl fluoride	184
	Acetyl fluoride	185
	Chloracetyl fluoride	189
	Trichloroacetyl fluoride	190
	Propionyl fluoride	191
	Dichlorofluoroacetyl fluoride	192
	Difluoroethyl sulfide	192
	Benzoyl fluoride	195
	p-Fluorobenzenesulfonyl chloride	197
	Bromofluoroacetic acid	197
	Fluorobenzene	197
	Carbonyl fluoride	198
	Oxalyl fluoride	198

CWM 27: Tetrachlorides, Silicon, Tin, Titanium, Part I, Austin M. Patterson and Clarence J. West, May 1919 [2 copies]

<u>I</u>	<u>Methods of Preparation</u>	
	Tin Tetrachloride	1
	Manufacture	13
	From Cassiterites	17
	Silicon Tetrachloride	23
	Manufacture	48

	Titanium Tetrachloride	50
	Manufacture	62
<u>II</u>	<u>Physical Properties</u>	
	Tin Tetrachloride	68
	Aqueous solution	81
	Silicon Tetrachloride	85
	Aqueous solution	93
	Titanium Tetrachloride	94
	Aqueous solution	99
<u>III</u>	<u>Chemical Reactions</u>	
	Tin Tetrachloride	
	Inorganic reactions	101
	Organic reactions	108
	Silicon Tetrachloride	
	Inorganic reactions	115
	Organic reactions	129
	Titanium Tetrachloride	
	Inorganic reactions	136
	Organic reactions	149
<u>IV</u>	<u>Action on Metals</u>	
	Tin Tetrachloride	158
	Silicon Tetrachloride	161
	Titanium Tetrachloride	164

CWM 27: Tetrachlorides, Silicon, Tin, Titanium, Part II, Austin M. Patterson and Clarence J. West, May 1919 [2 copies]

<u>V</u>	<u>Analysis</u>	
	Tin Tetrachloride	165
	Silicon Tetrachloride	169
	Titanium Tetrachloride	170
<u>VI</u>	<u>Physiological Effects</u>	
	Tin Tetrachloride	175
	Silicon Tetrachloride	175
	Titanium Tetrachloride	176
<u>VII</u>	<u>Smoke Production</u>	
	Apparatus	177
	Units Employed	183
	Tin Tetrachloride	187
	Silicon Tetrachloride	195
	Titanium Tetrachloride	197
<u>VIII</u>	<u>Comparison with Phosphorus</u>	
	Titanium Tetrachloride	201
	Stannic Chloride	204
<u>IX</u>	<u>Use in Berger Smoke Mixture</u>	
	Silicon Tetrachloride	205
	Titanium Tetrachloride	206
	Stannic Ammonium Chloride	208
<u>X</u>	<u>Navy Smoke Funnel</u>	
	Propellant	211
	Description	220
	Operation	221
<u>XI</u>	<u>Smoke Knapsack</u>	

	Description	222
	Operation	223
<u>XII</u>	<u>Smoke Float</u>	
	Silicon Tetrachloride	224
<u>XIII</u>	<u>Dugout Grenade</u>	
	Filler	225
	Relative Value of Tetrachlorides	226
	Description	229
<u>XIV</u>	<u>Use in Shell</u>	
	Silicon Tetrachloride	232
	Titanium Tetrachloride	233
<u>XV</u>	<u>Incendiary Bomb</u>	
	Stannic Chloride	235
<u>XVI</u>	<u>Relative Value</u>	
	Smoke Grenade	236
	Smoke Funnel	237
	Shell	237
<u>XVII</u>	<u>Filters</u>	
	Method of Testing	241
	Protection	242
	Filter Cartridge	250
<u>XVIII</u>	<u>Comparison of Canisters</u>	
	Stannic Chloride	253
	Silicon Tetrachloride	255
	Titanium Tetrachloride	256
<u>XIX</u>	<u>Plugging Canisters and Filters</u>	
	Silicon Dioxide	261
	Stannic Chloride	261
	Silicon Tetrachloride	262
	Canister Clogging	269
<u>XX</u>	<u>Mixtures</u>	
	Phosgene and Stannic Chloride	281,288
	Phosgene, Arsenic Trichloride and Stannic Chloride	282
	Chloropicrin and Stannic Chloride	283
	Hydrocyanic Acid and Stannic Chloride	291
	Green Star and Stannic Chloride	291

CWM 28: Bromobenzyl Cyanide, Clarence J. West, May 1919 [2 copies]

Preparation	1
Manufacture	3
Properties	42
Analysis	48
Efficiency of Canisters	53
Protection	55
Cleaning of Objects Contaminated with Bromo-	
benzyl Cyanide	58
Physiological	59
Persistence	66
Tactical Use	72
Toxic Smoke	73
Shell Linings	73
Detonation	85

Comparison with Chloroacetophenone	92
Effect of Acidity	92
Grenades	93
4-Bromophenyl Bromoacetonitrile	95
4-Chlorophenyl Bromoacetonitrile	96
Bromoxylyl Cyanide	
Preparation	97
Toxicity	98
Man Tests	99

CWM 29: Acrolein, Clarence J. West, May 1919

I	Acrolein	
	Introduction	1
	Preparation	2
	Operation	31
	Purification	32
	Polymerization	37
	Stabilization	45
	Analysis	
	Qualitative	49
	Quantitative	51
	Testing the Efficiency of Canisters	55
	Absorption	58
	Protection	59
	Physiology	59
	Sensitiveness of Individuals	62
	Treatment	64
	Tactical Use	65
	Shell Filling	65
	Bibliography	68

CWM 30: Halogenated Ketones (Bromoacetone) and Esters, Clarence J. West, May 1919

Part I		
	Introduction	1
I	Bromoacetone	
	Preparation	6
	Properties	17
	Stability	22
	Mixtures	29
	Analysis	31
	Physiological	35
	Toxicity	36
	Lachrymator	37
	Pathology	39
	Shells	40
	Linings	42
	Stability on Detonation	51
	Persistency	54

	Gas Grenades	58
<u>II</u>	<u>Chloroacetone</u>	
	Preparation	60
	Properties	66
	Analysis	69
	Canister Testing	71
	Physiological	73
<u>III</u>	<u>Iodoacetate</u>	
	Preparation	75
	Properties	79
	Physiological	80
<u>IV</u>	<u>Symmetrical Dichloroacetone</u>	
	Preparation	82
	Physiological	83
	Toxic Smoke	85
	Unsymmetrical Dichloroacetone	87
	Trichloroacetone	89
	Tribromochloroacetone	90
<u>V</u>	<u>Martonite</u>	
	Preparation	92
	Manufacture	106
	Properties	110
	Physiology	112
	Military Value	113
<u>VI</u>	<u>Bromomethylethyl Ketone</u>	
	Preparation	116
	Properties	117
	Physiology	119
	Protection	123
	Shell	124
<u>VII</u>	<u>Homomartonite</u>	125
	Part II	
<u>VIII</u>	<u>Ethylbromoacetate</u>	
	Preparation	128
	Properties	129
	Toxicity	131
	Shell	131
<u>IX</u>	<u>Allyl Chloroacetate</u>	
<u>X</u>	<u>Ethyliodoacetate</u>	
	Preparation	134
	Properties	138
	Analysis	140
	Physiology	141
	Protection	147
	Treatment of poisoning	147
	Shell	151
	Travel of Vapors	159
	Mixtures with HCN	163
	Dibromovinylacetate	167
	Methyl-dl-Phenylbromoacetate	167
	Methyl-dl-Phenylchloroacetate	168
	Ethyl-dl-Phenylchloroacetate	170

CWM 31: Aromatic Halides (Benzyl and Xylyl), Clarence J. West, May 1919

I	<u>Benzyl Bromide</u>	
	Preparation	1
	Properties	3
	Analysis	5
	Absorbent testing	5
	Canister testing	7
	Physiology	10
	Absorption	12
	Permeability	12
	Protection	12
	Destruction	14
	Storage	15
II	<u>Benzyl Chloride</u>	
	Preparation	18
	Manufacture	21
	Properties	23
	Analysis	29
	Physiological	30
	Capsicum, action of	30
III	<u>Benzyl Iodide</u>	
	Preparation	31
	Properties	33
	Lachrymatory properties	33
	Fraissite	34
IV	<u>Derivatives of Benzyl Halides</u>	
	p-Bromobenzyl Bromide	35
	o-Bromobenzyl Bromide	37
	p-Chlorobenzyl Bromide	37
	o-Chlorobenzyl Bromide	41
	2,4-Dichlorobenzyl Bromide	41
	Chlorobenzyl Chloride	47
	Chlorobenzyl Iodide	47
	Chloro-o-nitrobenzyl Chloride	47
	o-Cyanobenzylchloride	48
	p-Cyanobenzyl Chloride	48
	m-Iodobenzyl Bromide	49
	p-Nitrobenzyl Bromide	49
	o-Nitrobenzyl Bromide	49
	o-Nitrobenzyl Chloride	50
	p-Nitrobenzyl Chloride	51
	Cedenite	51
	Dinitrobenzyl Chloride	52
V	<u>Xylyl Bromide</u>	
	Preparation	53
	Properties	59
	Mixtures	65
	Analysis	66
	Absorption	68
	Permeability	69
	Man test	70
	Removal from wood	71

	Shell	72
	Detonation	86
	Toxic Smoke	87
<u>VI</u>	<u>Xylyl Chloride</u>	88
	Xylyl Iodide	88
	Xylylene Chloride	89
	Xylylene Bromide	89
	Chloro-m-xylylene Bromide	89

CWM 32: Chloroacetophenone, Part II, Clarence J. West, May 1919

<u>VI</u>	<u>Chloroacetophenone (cont'd)</u>	
	Analysis	151
	Testing the Efficiency of Canisters	155
	Physiology	163
	Sensitiveness	166
	Protection	168
	Persistency	172
	Toxic Smoke	174
	Use in Smoke Screen	188
	Use in Shell	190
<u>VII</u>	<u>Bromoacetophenone</u>	213
	Toxicity	215
	Sensitivity	215
	Use as Toxic Smoke	216
	Physiological Effect	217
<u>VIII</u>	<u>Iodoacetophenone</u>	219
	Toxicity	219
<u>IX</u>	<u>Chloro-4-Bromoacetophenone</u>	222
	Toxicity	222
	Lachrymatory Power	222
	Skin Irritant Properties	223
	Toxic Smoke	223
<u>X</u>	<u>4-Dichloroacetophenone</u>	225
	Physiological	225
	Toxic Smoke	226
<u>XI</u>	<u>Dichloroacetophenone</u>	228
<u>XII</u>	<u>W.W. Dichloroacetophenone</u>	235
	Physiological	235
<u>XIII</u>	<u>Trichloroacetophenone</u>	236
	Preparation	236
<u>XIV</u>	<u>Use of P-Methoxy-Chloroacetophenone and P-Methyl-Chloroacetophenone as smokes</u>	238
<u>XV</u>	<u>Ethoxy Chloroacetophenone</u>	242
<u>XVI</u>	<u>Chloroacetotoluone</u>	250
	Toxicity	250
<u>XVII</u>	<u>Chloroacetoxyline</u>	251
	Lachrymatory Power	251
	Use as Toxic Smoke	251
<u>XVIII</u>	<u>B-Chloropropiophenone</u>	253
	Toxic Smoke	256
<u>XIX</u>	<u>Bromobutyrophenone</u>	259
	Toxicity	259

	Toxic Smoke	259
<u>XX</u>	<u>Chloroacetodiphenyl oxide</u>	261
	Toxic Smoke	262
<u>XXI</u>	<u>Chloroaceto Diphenyl Sulfide</u>	265
<u>XXII</u>	<u>Chloroaceto Thienone</u>	267
	Toxic Smoke	267

Bibliography

Index

CWM 33: Lachrymators and Miscellaneous (same as CWM 15, Part VIII), Clarence J. West

Acetonitrile	2
Allyl amine	4
Allyl cyanide	6
Allyl isothiocyanate	8
Amyl isothiocyanate	11
Benzoyl fluoride	12
Bromoacetyl bromide	13
Bromoacetaldehyde	14
Bromoacetonitrile	15
Bromophenol	16
Bromophenyl bromoacetonitrile	17
Capsicum	18
Chloroacetonitrile	31
Chloroacetyl fluoride	32
Chloroethyl chloroformate	33
2-Chloroethyl sulfide	34
B-Chloroethyl thiocyanate	35
2-Chloromethyl butyl ether	37
1-Chloromethyl A-chloroethyl ether	38
Chloromethyl chloroformate	40
4-Chlorophenyl bromoacetonitrile	41
Chloropicrin	42
Crotonic aldehyde	43
Cyanogen compounds	44
Dibromomethyl ether	45
Dichlorodinitromethane	48
A,A-Dichloroethyl ether	49
s-Dichloromethyl ether	52
Ethyl chlorosulfonate	55
Iodoacetaldehyde	57
Iodoacetonitrile	58
Methyl chloroformate	59
Methyl chlorosulfonate	60
Mustard oils	64
Naphthalene tetrachloride	65
Perchloromethyl mercaptan	66
Phenylcarbylamine chloride	67
Phenylisothiocyanate	74
Thionyl aniline	77
Thiophosgene	78
Trichloroacetyl chloride	79

Trichloroacetyl fluoride	80
Trichloroacetonitrile	81
Trichloronitroethylene	85

CWM 36: Camouflage Gases (Butyl Mercaptan, etc), Clarence J. West, May 1919 [2 copies]

Introduction	1
<u>I Butyl Mercaptan</u>	
Preparation	7
Method of analysis	32
Manufacture	36
Properties	45
Action on metals	51
Man test	52
Protection	55
Masking effect on odor of Mustard Gas	55
Masking of Chloropicrin	64
Comparison with Mustard Gas	67
Comparison with Ethyl Mercaptan	71
Suggested Tactical use	73
<u>II Ethyl Mercaptan</u>	
Preparation and Properties	75
Toxicity	76
Man test	76
<u>III 4-Chlorophenyl Mercaptan</u>	78
<u>IV Benzyl Mercaptan</u>	79
<u>V Dichlorobenzyl Mercaptan</u>	81
<u>VI Dimethyl Trithiocarbonate</u>	
Manufacture	82
Toxicity	83
<u>VII Methyl-n-Butyl Trithiocarbonate</u>	94
<u>VIII Ethyl-n-Butyl Trithiocarbonate</u>	96
<u>IX Methyl Ethyl Trithiocarbonate</u>	97
<u>X Di-n-Butyl Trithiocarbonate</u>	98
<u>XI Allyl Isocyanide</u>	99
<u>XII Allyl Isothiocyanate</u>	101
<u>XIII Benzyl Disulfide</u>	104
<u>XIV Phenyl Isothiocyanate</u>	105
<u>XV Trichloroacetylthiocyanate</u>	107
<u>XVI Methyl Chlorothiocarbonate</u>	110
<u>XVII Ethyl Thiocyanacetate</u>	111
<u>XVIII Mercaptol</u>	113

CWM 37: Ricin, Reid Hunt, Worth Hale, J. M. Looney, C.C. Lund, R.R. Williams, 30 Sep 1918

<u>I Introduction</u>	
Albumin nature of ricin	2
Biological tests for ricin	3
<u>II Quantitative Tests for Ricin based upon the Agglutination of Red Blood Corpuscles</u>	
Historical	4

	A. Method	8
	a. Choice of blood; variations of different corpuscles	8
	b. Concentration of red cells used; quantitative relations	10
	c. The suspension of the red cells; inhibitory action of serum	11
	d. End point in agglutination experiments	
	1. Filter paper; variations in	13
	2. Time in relation to end point	14
	3. Temperature in relation to end point	14
	e. Technique for carrying out the test	15
	f. Application of the test to different preparations of Ricin	16
	g. Parallelism of agglutination and toxicity tests	17
III	<u>The extraction of active Preparations of Ricin</u>	
	General principles involved; solubilities of ricin	18
	1. The solvent	21
	Water vs. salt solution	
	2. Methods of extraction	
	(a) Percolation: disadvantages of	22
	(b) Maceration	23
	i. Relative amounts of solvent and bean meal	23
	ii. Time of maceration	24
	iii. Serial maceration	25
	3. Factors influencing the completeness of extraction of castor oil bean	27
	i. Fineness of the meal; presence of hulls	27
	ii. Residual oil	29
IV	<u>Methods of Purifying Ricin</u>	
	1. Absorption methods; alumina cream	
	Fuller's earth; animal charcoal	29
	a. Insoluble soaps	31
	b. Carbonate precipitates; barium, calcium strontium	32
	c. Copper ferricyanide	33
	2. Precipitate experiments	33
	a. The ammonium sulfate precipitate	
	Previous work; principles involved.	
	Preparations of Ricin obtained by filtration and drying and ammonium sulfate precipitates. Toxicity and physical properties of the precipitates; yield of; ammonium sulfate required	33
	b. Magnesium sulfate precipitation	38
	c. Precipitation with picric acid	
	Picric acid required; yield of the acid compound. Toxicity and properties of the compound	
	38	
	d. Other experiments	
	i. Dialysis of the aqueous extract	42
	ii. Ethyl and methyl alcohol precipitates	43
	iii. Acetone precipitates	47
	3. Properties and Availability of the crude dried	

	extract	49
V	Yield and Toxicity of the extract	
	<u>Stability and keeping properties of Ricin</u>	52
	Resistance of ricin to enzymes, bacteria, heat, etc.	52
	Preservatives; effect of on agglutination and toxicity	55
	Heat destruction of ricin	67
VI	<u>Toxicity of Ricin</u>	
	1. Purity and character of the preparation	69
	Toxicity of the meal as such; age of bean; toxicity of different crops; nature of ricin; resemblance to toxins	
	2. Method of administration	73
	Toxicity when administered by mouth; sub- cutaneous, intramuscular, etc. injection	
	3. Fatal dose and fatal period	76
	One dependent on the other Incubation period	
	4. Species Susceptibility	81
	Lower organisms; vertebrates	
	5. Toxicity of Ricin for Man	86
Fatal doses of the beans		
6. Toxicity of Ricin as a dust	88	
Absorption from the respiratory tract Dust experiments		
VII	<u>Symptoms and Pathology of Ricin Poisoning</u>	91
	1. General effects and pathological changes from subcutaneous, etc. injections	91
	Mice and Rats	
	Guinea Pigs	
	Rabbits	
	Cat	
	Dog	
	2. Special Symptoms	98
	Temperature	
	Urine changes	
Blood changes		
3. Local Effects	99	
Subcutaneous injection; local necrosis		
Eye; injury to from Ricin		
4. Poisoning by Ricin in Man	103	
Source of poisoning		
Symptoms; fatal dose		
VIII	<u>Possible uses in warfare</u>	107
	1. Use of Shrapnel bullets	107
	Experiments of Williams; method of applying the ricin to bullets; Amount adhered to bullets; firing trials	
	Use of paraffin as a matrix	111
	Preparations of ricin available for coating bullets	113
	Availability of material	114
	2. Use as dust cloud	115
	a. Toxic action through respiratory tract	115
	b. Injurious action on the eye	116
		<u>The Castor Oil Industry</u>

	1. Sources of beans	117
	Imported beans; domestic production	
	2. Methods of milling	119
	3. Availability of cake	120
X	<u>Immunity to Ricin; Antiricin</u>	120
	Immunization of animals to ricin	
	Production and properties of antiricin	
	Hypersusceptibility; anaphylaxis	
XI	<u>Bibliography</u>	126

CWM 38: Protective Clothing, Part I, Arthur E. Hill, May 1919 [2 copies]

I	<u>Skin Irritants</u>	
	1. Introduction	1
	2. Activity of Various Skin Irritants	3
	A – Severe Irritants	3
	B – Mild Irritants	4
	C – Non-Irritants	6
	3. Methods of Testing Skin Irritant Activity	8
	4. Symptomology of Skin Burns	9
	5. Variations in Susceptibility	12
	6. Localization of Skin-Burns by Mustard Gas	20
	7. Casualties due to Skin-Burns	21
II	<u>Permeability of Fabrics</u>	
	8. Penetration of Untreated Fabrics	23
	Untreated Textiles	24
	Leather	25
	Rubber	26
	9. Methods for Testing Penetration	26
	A. Methods for Testing Penetration by	
	Mustard Gas	27
	Liquid Mustard	27
	Vapor Tests	35
	I. Standard Physiological Methods	37
	II. Standard Chemical Methods	39
	B. Methods for Testing Penetration by	
	Methyldichloroarsine	41
	C. Methods for Testing Penetration by	
	Miscellaneous Gases	42
III	<u>Protective Gloves</u>	
	10. Rubber Gloves	43
	11. Leather Gloves	
	A – Linseed-oil Treatment	44
	B – Wax-oil Treatment	46
	C – Two Fabric Glove	47
	12. Cotton Gloves	
	A. Linseed-oil Treatment	49
	B. Gelatin-glycerin Treatment	51
	C. Gelatin-acacia-glycerin Treatment	52
	D. Cellulose-nitrate Treatment	53
IV	<u>Protective Overall Suits</u>	
	13. Physiological Facts connected with Protective Suits	60
	14. Impermeable Suits	

A.	Oil-skin Suit	66
B.	Nitrocellulose Suit	76
C.	Air-lined Suit	77
D.	Wax-impregnated Leather Suit	80
15.	Semipermeable Suits	
A.	Gelatin-glycerin Suit	81
B.	Gelatin-acacia-glycerin Suit	89
16.	Permeable Suits	
A.	The Simplexene Suit	92
B.	The Emulsoid Suit	102

CWM 38: Protective Clothing, Part II, Arthur E. Hill, June 1919

<u>V</u>	<u>Protective Underclothing</u>	
	17. Semipermeable Underwear	115
	18. Permeable Underwear	116
<u>VI</u>	<u>Protective Footwear</u>	
	19. Boots and Shoes	126
<u>VII</u>	<u>Protection of Animals</u>	
	20. Horse Mask	128
	21. Dog Mask	136
	22. Horse Boot and Pad	
	A. Horse Boot	138
	B. Hoof Pad	143
	C. Hoof Packing	145
<u>VIII</u>	<u>Dugout Protection</u>	
	23. Fabrics for Curtains	148
	24. Aqueous Impregnating Mixtures	152
	25. Oil Impregnations	152
	26. Nitrocellulose Treatment	158
	27. Gelatin-Glue Treatment	159
	28. Tars and Tarpapers	161
<u>IX</u>	<u>Demustardization of Fabrics</u>	
	29. Demustardization by Evaporation	164
	30. Demustardization by Extraction	167
	31. Demustardization by Chlorinating and Oxidizing Agents	170
	32. Demustardization by Hydrolysis	
	A. Cold Water Treatment	171
	B. Alcohol Treatment	172
	C. Steam Treatment	174
	D. Accelerated Hydrolysis	175
<u>X</u>	<u>Theory of Protection by Treated Fabrics</u>	
	33. Penetration of Fabrics	180
<u>XI</u>	<u>Chemical Destructive Agents for Mustard Gas</u>	
	34. Chloramine Fabrics	186
	35. Aromatic Iodide-dichlorides and Iodoso- compounds	191
	36. Perhalogenated Phenols	192
	37. Chloramines of Sulphonic Acid	195
	38. Halogen Amines of Carboxy Acids	197

CWM 39: Protective Ointments, Part I, W. Lee Lewis, May 1919 [2 copies]

I	<u>Introductory</u>	
1.	The need of protective preparations	1
2.	The advantages and disadvantages of protective preparations	2
3.	Specifications for a desirable protective paste preparations	4
II	<u>Methods of Testing Protective Preparations</u>	
1.	Method of Wilson and Fuller	6
2.	Method of Duecker and Wiesberg	17
3.	Method of Major Farr	20
4.	Method of Marshall	21
5.	Method of Amberg, Austin and Hemholtz	26
6.	Method of Sollman	27
III	<u>Types of Protective Preparations</u>	
1.	Oils	29
2.	Ointments	33
a.	Ointments prepared in Wilson's laboratory	33
b.	Substances used in protective ointments by Wilson	56
c.	Wilson's final discussion of ointments	58
aa.	Introductory	58
bb.	Preliminary determination of best ointment base	60
cc.	Direct comparison of bases	61
dd.	Direct comparison of zinc stearate oleate and linoleate	62
ee.	Complete comparison of bases and of soaps	62
ff.	Composition of bases	63
gg.	Preliminary comparison of metallic soaps	63
hh.	Detailed study of best types of ointments	65
ii.	Complete comparison of soaps and oxides	67
jj.	Complete comparison of bases	68
kk.	Composition of ointments No. 1, 16, 31, 34 and 41	69
ll.	Intensive study of oxide ointments	70
mm.	Comparison of all ointments averaging below 50% burns	71
nn.	Composition of best CaO ointments	73
oo.	ZnO ointments	75
pp.	Modifications of ointment No. 66	76
qq.	Other materials tried in ointments	81
rr.	Ointments submitted by other laboratories	83
d.	Reports on protective ointments by Marshall	85
e.	Work of the A.E.F. laboratory on protective ointments	105
f.	Contributions of the Italians on protective ointments	146
g.	Contributions of the French on protective ointments	151

CWM 39: Protective Ointments, Part II, W. Lee Lewis, May 1919 [2 copies]

<u>III</u>	<u>Types of Protective Preparation (cont'd)</u>	
	h. Contributions of the British on protective ointments	162
	i. Miscellaneous ointments and protective preparations	187
<u>IV</u>	<u>The Mechanism of Ointment Protection</u>	
	1. Wilson's discussion	219
	a. The Chemical Theory	219
	b. The Penetration Theory	221
	c. The Mechanical Theory	223
	d. The Physical Theory	224
	2. Views of Duecker and Weisberg	227
	3. Views of the Italians	229
	4. Views of the British	230
	5. Chisholm's Discussion	231
	6. Present theory of Mustard Gas action on the skin	250
	7. Critical Summary	260
<u>V</u>	<u>The Probable Value of Protective Ointments</u>	
	1. Incompleteness of data on which this monograph is based	271
	2. Conflicting data in the available records	271
	3. Critical Summary	304

CWM 41: Signal Smokes, Part I, Arthur B. Ray, May 1919 [2 copies]

	Introduction	1
<u>I</u>	<u>Production of Smoke Signals</u>	
	I. Smokes Produced by Dispersing Solids	
	A. Dispersion by means other than explosion	2
	B. Dispersion by explosion	4
	II. Smokes Produced by Chemical Reaction	
	General	7
	A. Low Temperature Reaction Smokes	7
	B. High Temperature Reaction Smokes	
	1. Attempts to produce colored smokes at the Royal Naval Experimental Station	9
	2. Production of colored smokes by causing to react with a chlorinating agent	
	General	12
	(a) "Iron Smoke"	13
	(b) Attempts to use other metals for smoke production	15
	3. "Pitch Smoke" – Smoke produced by destructive distillation of pitch	16
	4. "Arsenic Sulfide Smoke" – Smoke produced by formation and volatilization of Arsenic Sulfide	19
	5. "Black Smoke" – Smoke produced by decomposition of Organic Compounds	23
	6. Miscellaneous	28

III.	Smokes Produced by Volatilizing Colored Materials	
A.	Use of Berger Type Smoke Mixture	
1.	"Iodine Smoke"	29
B.	Dye Smokes	
1.	Introduction	32
2.	General Considerations	34
3.	Containers used and method of igniting	35
4.	Later modifications	37
5.	Development of Red Smoke	41
6.	Development of Yellow Smoke	45
7.	Development of Blue Smoke	46
8.	Development of Green Smoke	47
9.	Development of Purple Smoke	47
10.	Dyes and other materials tested	48
C.	Miscellaneous	53
<u>II</u>	<u>Use of Signal Smokes</u>	
I.	British Smoke Signalling Devices	
General		62
A.	Smoke signals for use by Royal Air Force	
1.	Non-parachute signals (Various) fired from aircraft and functioning in the air	63
2.	Signals fired from aircraft and functioning on impact	64
3.	Very signal cartridges (1½)	64
4.	Colored smoke shell	65
B.	Other Smoke Signalling Devices	
1.	3" Mortar Daylight Signal	65
2.	Rifle grenade Daylight Signal No. 31	65
3.	Rifle grenade Daylight Signal No. 42	70
4.	Remarks concerning Rifle grenade and Rocket Signal Smokes	70
5.	Message Carrying Rocket	72
6.	Use of Smoke Shell in Signalling	74
7.	Colored Smoke Shell	75
8.	Dummy Drop Bomb Signals	75
II.	French Smoke Signalling Devices	
General		88
A.	List of Smoke Signals	89
B.	Remarks concerning Signals	
1.	Red Smoke Rocket	89
2.	Yellow Smoke Rocket	89
3.	25 mm Red or Yellow Smoke Cartridge	89-a
4.	35 mm Red or Yellow Smoke Cartridge	89-a
5.	35 mm Message Carrying Cartridge	90
6.	Message Grenade – Bissiere Model	91
7.	Dummy Drop Bombs	93
III.	Italian Smoke Signalling Devices	94
IV.	German Smoke Signalling Devices	
A.	Smoke Candle	94
B.	Use of smoke producing substances in H.E. Shell	95
C.	Smoke Message Cartridge	100
V.	U.S. Army Smoke Signalling Devices	
General		101
A.	Smoke Signals – Complete List	103

B. Description of Signals	
1. Yellow and Red Smoke Signal Rocket	104
2. Smoke Tracers on Rockets	117
3. V.B. Yellow Smoke Cartridges	119
4. V.B. Discharger Cup	124
5. 25mm Very cartridge – yellow smoke	125
6. 35 mm Yellow and Red Smoke Cartridge	132
7. 25 mm and 35 mm Signal Pistols	138
8. Smoke Torch	139
9. Message Rifle Grenade	143
10. Hand Message Carrier – aviation	143
11. Smoke Spotter	145
12. Smoke Signal Requirements of A.E.F.	146
13. Dummy Drop Bombs	146

CWM 41: Signal Smokes, Part II, Arthur B. Ray, May 1919

<u>II</u>	<u>Use of Smoke Signals (cont'd)</u>	
VI.	Smoke Signals developed by Chemical Warfare Service	
A.	Description of Signals	157
1.	Signal Parachute Rockets – Colored Smoke	
Discussion	157	
Specifications and Drawings	158	
2.	Signal Rockets – “Trailer Type” Colored Smoke	
Discussion	170	
Specifications and Drawings	174	
3.	Rifle Grenade Signals	
Discussion	193	
Specifications and Drawings	194	
3a.	Submarine recognition Signals	
	Discussion	211
4.	Smoke Signal Grenade – aviation	
Discussion	230	
Specifications	231	
5.	Very Signal Cartridges – Colored Smoke	
Discussion	252	
6.	Smoke Candles for Signalling	255
7.	Dummy Drop Bomb Smoke Signal	256
8.	Smoke Signals for use by Navy	267

CWM 42: Toxic Smokes, Part I, Clarence J. West, May 1919 [2 copies]

<u>I</u>	<u>The Production of Toxic Smokes</u>	
	Definitions	1
	Motion of Particle	2
	Rate of Settling	2
	Methods of Formation	6
	Mechanical Dispersion	6
	Thermal Dispersion	6
	Explosive Dispersion	10
<u>II</u>	<u>Size of Smoke Particles</u>	

General	15
Measurement	20
Corona method	20
Microscope slide method	21
Ultra microscopic method	23
Different methods	25
Oscillation method	27
Evaporation and recondensation	33
Repeated detonation	34
Tyndallmeter reading and size of particles	37
Size of particle produced by standard F-10 machine	39
III	
<u>The Tyndallmeter</u>	
General	42
Description	43
Standardization	45
Absolute standardization	46
New method of lamp regulation	48
IV	
<u>Relation between the Intensity of the Tyndall Beam and concentration of Suspension and Smokes</u>	
Silica Suspension	50
Ammonium Chloride Smokes	51
Concentration of Toxic Smokes	53
V	
<u>Relation between Intensity of Tyndall Beam and Size of Particles</u>	
General	56
Particles in smoke	57
Particles in suspension	60
VI	
<u>An Electrical Smoke Precipitator</u>	
General	69
Description of Cottrell apparatus	70
Concentration of certain toxic smokes	72
VII	
<u>Factors Influencing Smoke Production by Explosive Dispersion</u>	
Chemical and physical nature of smoke material	79
Effect of powdering and drying	81
Chemical and physical nature of explosive	84
Ratio of explosive to toxic material	89
Relative distribution of explosive and toxic material	92
Influence of strength of container	94
Effect of shape and size of bomb	104
Effect of a confining chamber	106
Effect of temperature	109
Loading of explosive	111
Summary	112

CWM 42: Toxic Smokes, Part II, Clarence J. West, May 1919

VIII	<u>The Dissipation of Smokes</u>	
	Theoretical	115
	Smoke box	116
	Effect of stirring on rate of dissipation	117
	Effect of concentration	118
	Effect of size of particles	120

<u>IX</u>	Maximum smoke density obtainable	121
	<u>Penetration of Toxic Smokes</u>	
	Kinetic theory of smoke filtration	123
	Method of testing penetration	127
	Standard filter	127
	Standard rate of flow	128
	Apparatus	128
	Percentage penetration	131
	Smoke density	132
	Penetration of canisters	132
	Clogging of filter	134
	Age of smoke	135
	Smoke density	137
	Rate of flow	137
	Penetration of felts	138
	Selection of particles in penetration	140
	Method of dispersion	143
	Ratio of explosive to toxic	143
	Nature of explosive	145
	Effect of impurities	146
	Strength of container	147
	Compactness of loading	148
	Mixing of explosive and toxic	149
	Thermal and explosive dispersion	149
	Medium and small scale smokes	150
	Effect of detonation	153
	Smoke by explosive dispersion	153
	Smoke by thermal dispersion	154
	Small scale tests	155
	Medium scale tests	156
	Results of tests	159
	Relation of constitution to penetration	160
<u>X</u>	<u>Dispersoid Shell Pit</u>	
	Construction	166
	Equipment	167
<u>XI</u>	<u>Smoke Candle</u>	
	Dispersoid D.M. smoke candle	170
	Specifications	171
	Functioning	175
	Stability of mixture	177
	Tests	181
	Penetrating power of smoke	184
	British D.M. Candle	187
	Dispersoid Diphenylchloroarsine candle	190
	Specifications	192
	Stability of mixture	195
	Tests	195
	Pyrotechnic toxic smoke candle	198
	Specifications	199
	Stability	212
	Comparison of penetrating power of smoke of two candles	213
	Protection against smoke of toxic candle	216
<u>XII</u>	<u>Three Inch Stokes Mortar Shell for Thermal Dispersion</u>	

	General	229
	Tests	231
<u>XIII</u>	<u>Modified Hand Grenade for the Thermal Dispersion of D.M.</u>	
	General	233
	Tests	235
<u>XIV</u>	<u>Dispersoid Shell</u>	
	General	236
	Factors influencing efficiency of dispersion of diphenylchloroarsine	237
	Modification of gas shell and boosters	238
	Type A	239
	Type L	240
	Type S-J	240
	Calculated stress in long boosters	241
	Ballistic tests	242
	Mechanical requirements of long boosters	252
	Type G shell	253
	Special boosters	256
	Storage tests	257
	Effect of set back	257
	Method of loading	258
	Static tests of shell	260
	Ballistic tests of shell loaded with Diphenyl-chloroarsine and T.N.T.	262
	Summary	267

CWM 42: Toxic Smokes, Part III, Clarence J. West, May 1919 [2 copies]

<u>XV</u>	<u>General Properties of Toxic Smokes</u>	
	Essentials of a good toxic smoke	268
	Methods of testing properties	268
	Physiological properties	268
	Concentration	269
	Quantitative relationship for smokes	272
	Table of substances tested	278
	Relation to chemical constitution	283
<u>XVI</u>	<u>Description of Smokes from Various Compounds</u>	
	Detonators	289
	Explosives	291
	Arsenic Trichloride	293
	Arsenic Tribromide	294
	Arsenic Trioxide	295
	Magnesium Arsenide	296
	Chlorosulfonic Acid	296
	Ethyl Chlorosulfonate	299
	Fluorosulfonic Acid	300
	Ethyl Fluorosulfonate	303
	Lead Acetate	305
	Sodium Fluoride	305
	Mercuric Chloride	306
	Phosphorus Pentachloride	307
	Phosphorus Trichloride	308

Sodium Cyanide	309
Sodium Acetate and Sodium Nitrite	310
Barium Salts	313
Bromoacetamide	318
Dimethylsulfate	319
Mustard Gas	320
Mustard Gas – TiCl ₄	323
Selenium Mustard Compound	324
Dichloroethyl Selenide	325
Dichloroethyl Telluride Dichloride	326
Mustard-1 Oxide	327
Mustard-1	328
Cyanogen Bromide	330
Cyanogen Bromide and Arsenic Bromide	332
Cyanuric Bromide	334
Ethyl Cyanide	336
Cyanogen Sulfide	337
Thiosuperpalite	339
Phenylimidophosgene	342
Di-isothiocyanodimethyl Ether	343
Juglon and Juglon Acetate	343
o-Nitro Chlorobenzene	346
p-Nitro Chlorobenzene	347
Nitro Dichlorobenzene	349
Dinitrochlorobenzene	350
Diphenyl	351
Tolidine	353
Tolidine Sulfate	354
Dianisidine	354
Chloroacetanilide	355
p-Bromo Chloroacetanilide	357
o-Chloro Chloroacetanilide	358
p-Chloro Chloroacetanilide	358
m-Nitro Chloroacetanilide	359
Methyldichloroarsine	360
Diphenylchloroarsine	361
Phenyldichloroarsine	368
Comparison of Phenyl dichloroarsine and	
Diphenylchloroarsine	371
Diphenylcynoarsine	374
Diphenylphenoxyarsine	377
Triphenylarsine	378
Phosgene Triphenylarsine	379
D.M.	380
Basic Navy Blue D.A.	386
Bromi-D.M.	387
Cyano-D.M.	388
Iodo-D.M.	389
Thiocyanato-D.M.	389
Sym. Dichloroacetone	390
Tetrachlorodinitroethane	392
Mercury Trichloroethylene	393
Xylyl Bromide	395
Chloroacetyl diphenyl	396

Chloroacetyl Diphenyloxide	397
Phenylchloroacetate	398
Chloroacetophenone	399
Chloroacetophenone Oil	409
p-Bromo-w-Chloroacetophenone	411
p-Chloro-w-Chloroacetophenone	412
p-Methoxy-w-Chloroacetophenone	413
p-Methyl-w-Chloroacetophenone	414
Bromoacetophenone	414
Chloropropiophenone	416
Bromobutyrophenone	417
Chloroacetoxylene	417
Chloroacetothienone	418
Oils and Liquids	420
Oil "Smokefier"	422

CWM 43: Incendiaries, Part II (Pt 1), pp. 1- 187, Arthur B. Ray, May 1919 [2 copies, 1 w/o table of contents]

<u>III</u>	<u>Incendiary Shell</u>	
	General	1
	British Incendiary Shell	
	General	2
	General Specifications to Govern the Filling of	
	Incendiary Shell	
	2 pdr. Davis Gun A.Z. Shell	14
	1.59" Mark I (L) Shell	15
	6 pdr. Davis Gun A.Z. Shell	17
	6 pdr. Davis Gun Mark II (L) Shell	18
	75 mm French A.Z. Shell	19
	3" Mark III and V Shell (Filled D.W.	
	composition)	21
	3" Mark III Shell (Filled S.R. composition)	26
	18 pdr. (except A.Z.) Shell	28
	18 pdr. A.Z. Shell	30
	4.5" Howitzer Mark II (L) Shell	32
	6" Mark II (L)	35
	French Incendiary Shell	
	General	43
	Specifications for filling 75 mm Tracer Shell	51
	Specifications for filling 37 mm Tracer Shell	58
	Specifications for filling 105 mm Tracer Shell	62
	Italian Incendiary Shell	
	General	65
	25 and 37 mm Incendiary Tracer Shell	65
	102 mm Anti-Aircraft Incendiary Shrapnel	66
	Experimental Shell	67
	German Incendiary Shell	
	General	70
	Description of 2 cm Anti-Aircraft	71
	Description of 3.7 cm Tracer Shell	71
	Description of 7.7 cm Tracer Shell	72
	Description of 7.7 cm Incendiary	72
	Description of 7.7 cm Shrapnel/Incendiary Shell	73

Description of 13 cm Thermit Incendiary Shell	73
Description of 15 cm Incendiary Shell (Gr. 14 H)	74
Description of 15 cm Incendiary Shell (Brand – Gr.)	75
Description of 17 cm "Ninenwerfer" Incendiary Shell	76
Russian Incendiary Shell	
Description of 3" Incendiary Shrapnel	76
American Incendiary Shell	
General	82
37 mm Tracer – Incendiary Shell	83
75 mm and 3" Anti-Aircraft Tracer Shell	84
Thermit Shrapnel Shell	98
Incendiary Unit Shrapnel Shell	101
4.7" Base-opening Incendiary Shell	102
IV	
<u>Incendiary and Tracer Small Arms Ammunition</u>	
General	108
French Small Arms Ammunition	
General	109
11 mm Tracer Bullet	110
8 mm Tracer Bullet	114
Delay Tracer Bullet	116
7.7 mm Armor-Piercing Tracer Bullet	117
8 mm Phosphorus Bullet	118
English Small Arms Ammunition	
General	120
Caliber .303 Tracer Bullet – R.L.	120
Caliber .303 S.P.G. Tracer Bullet	121
Caliber .303 Buckingham Bullet	123
German Small Arms Ammunition	
General	125
Perforating and Tracer Bullet used in Aviation	125
8.2 mm Phosphorus Bullet	127
Tracer Bullet for 11.43 mm Rifle	128
Armor Piercing Illuminating and Incendiary Bullet	128
Armor Piercing Incendiary Bullet	129
Italian Small Arms Ammunition	
General	130
American Small Arms Ammunition	
General	131
.30 Caliber Incendiary Ammunition	135
.30 Caliber Tracer Ammunition – Model 1917	149
11 mm Tracer Incendiary Ammunition	169
Miscellaneous	187

CWM 43: Incendiaries, Part II (Pt 2), pp. 170-318, Arthur B. Ray, Jun 1919 [2 copies]

American Incendiary Bombs	
General	170
Intensive Incendiary Bomb – Mark II	172
Intensive Incendiary Bomb – Mark III	219
Scatter Incendiary Bomb – Mark I	232
Incendiary Darts	
General	265
Mark I Dart	268

Mark II Dart	290
Metal Incendiary Dart	308
Carrying and Releasing Device for Incendiary	
Dart, Mark I	308
Comparative Tests of British B.I. Bombs,	
Mark I and Mark II Darts	313
Mark I	313
Mark II	314
B.I. Bombs	314
Conclusions	315
Other Incendiary Bombs	
General	316
Flaming Torch Bomb	316
Ortiz Incendiary Bomb	316
Demolition Incendiary Bomb	318

CWM 43: Incendiaries, Part III (Pt 1), Arthur B. Ray, May 1919 [3 copies, 1 w/o table of contents]

<u>V</u>	<u>Incendiary Grenades and other Small Incendiary Devices</u>	
	General	1
	French Small Incendiary Devices	
	Phosphorus Grenades	2
	Thermite or "Calorite" Grenades	2
	J-1 Incendiary Can	11
	British Small Incendiary Devices	
	General	12
	Italian Small Incendiary Devices	
	General	13
	Thermite Grenades	13
	German Small Incendiary Devices	
	General	14
	Siemeus Incendiary Tube (Braudrobren)	14
	Auxiliary Incendiary Tube (Ersatz-Braudrobren)	15
	American Incendiary Grenades	
	General	19
	Thermit – Solid Oil Grenade	20
	Thermit Grenade	40
<u>VI</u>	<u>Incendiary French Mortar Projectiles</u>	
	General	57
	British Incendiary Projectiles	
	General	57
	Stokes' Thermit Bombs	58
	Livens' Projectiles	68
	American Incendiary Projectiles	
	General	69
	Stokes' Thermit Bombs	70
	Livens' Projectiles	76
<u>VII</u>	<u>Flame Projectors</u>	
	General	106
	German Flame Projectors	
	General	120
	Portable Flame Throwers	120
	Large Flame Throwers	129

Use of Flame Throwers	130
French Flame Projectors	
General	135
Schilt Apparatus	135
L-1 and L-2 Projectors	161

CWM 43: Incendiaries, Part III (Pt 2), Arthur B. Ray, May 1919

<u>VII</u>	<u>Flame Projectors (cont'd)</u>	
	French Flame Projectors (cont'd)	
	P-3 and P-4	163
	"Chapel" Portable Flame Projector	168
	Remarks	169
	British Flame Projectors	
	General	170
	"Hall" Flame Thrower	173
	"Hay" Flame Gun	173
	Lawrence Flame Projector	175
	Heavy Flame Projector	182
	Italian Flame Thrower	
	General	183
	D.L.F. Flame Thrower	184
	American Flame Thrower	
	General	186
	Knapsack Type	187
	Tractor Type	190
	Parapet Type	191
	Comparison of Principal Types of Portable Flame Projectors	198
<u>VIII</u>	<u>Miscellaneous Uses of Inflammable Materials</u>	
	German "Incendiary Blue Pencil"	202
	German Incendiary Device for Dissipating Gas	206
	Italian Heat Producers to Deflect Gas Waves	207
	British Method of Defending Trenches with Fire	209
	American Method of Defending Trenches with Fire	218
	American Airplane Demolition Device	231
	American Incendiary Very Star	237
	American Flaming Bayonet	238

CWM 44: Flares, Part I (Chaps 1-2), W. Lee Lewis and Arthur B. Ray, Jun 1919 [2 copies]

<u>I</u>	<u>Flare Compositions and Methods of Testing</u>	
	Introductory	1
	Methods of Testing Flares	
	Physical Methods	8
	American	8
	British	45
	Chemical Methods	64
	Composition of Flares	78
	Starting Mixtures	95
	Flares Proper	
	General	100

White Flares	104
--------------	-----

CWM 44: Flares, Part I (Pt 2), W. Lee Lewis and Arthur B. Ray, Jun 1919

<u>I</u>	<u>Flare Compositions and Methods of Testing (cont'd)</u>	
	Composition of Flares (cont'd)	
	Flares Proper (cont'd)	
	Red Flares	157
	Blue Flares	196
	Green Flares	197
	Yellow Flares	207
	Miscellaneous	208
<u>II</u>	<u>German Pyrotechnic Devices</u>	
	General	1
	Signalling and Illuminating Cartridges	2
	Rockets	19
	Signalling and Illuminating Projectiles	21
	Illuminating Shell	30
	Flares	37
	Illuminating and Signalling Devices	41
	Miscellaneous	48

CWM 44: Flares, Part II (Chaps 3-5), Arthur B. Ray, Jun 1919 [2 copies]

<u>III</u>	<u>British Pyrotechnic Devices</u>	
	General	1
	Very Cartridges	10
	Rifle Grenade Signals	45
	Rockets	51
	3" Mortar Signals	57
	3" Stokes Signal and Illuminating Bombs	58
	Flares	58
	Star Shell	67
<u>IV</u>	<u>French Pyrotechnic Devices</u>	
	General	83
	Very Cartridges – 25 mm	89
	Very Cartridges – 35 mm	94
	Rifle Grenade Signals – V-B	97
	Illuminating Hand Grenade	110
	Rockets	111
	Star Shell	118
	Bengal Lights – Ground Flares	143
	Illuminating Bombs	144
<u>V</u>	<u>Italian Pyrotechnic Devices</u>	
	General	152

CWM 44: Flares, Part III (Chap 6, Pt 1), Arthur B. Ray, Jun 1919 [3 copies]

<u>VI</u>	<u>American Pyrotechnic Devices</u>	
	General	1
	Rockets	18

V-B Signal Cartridges	61
Very Cartridges – 25 mm	149

CWM 44: Flares, Part III (Chap 6, Pt 2), Arthur B. Ray, Jun 1919 [2 copies]

<u>VI</u>	<u>American Pyrotechnic Devices (cont'd)</u>	
	Very Cartridges – 35 mm	216
	Position Lights or Flares	265
	Airplane Flares	305
	Illuminating Shell	349

CWM 46: The Properties of Canister Charcoal, Unimpregnated, Part I, Austin M. Patterson, May 1919

<u>I</u>	<u>Definitions</u>	1
<u>II</u>	<u>Standard Absorption Tests</u>	
	General	6
	Tube Tests	6
	Accelerated Chloropicrin test	7
	Summary of standard tube tests	10
	Canister Tests	11
	Standard intermittent testing machine	12
	Sampling	15
<u>III</u>	<u>Mesh</u>	
	1. Screen Sizes	17
	2. Screen Analysis	18
	Effect of speed of cutter	20
	3. Mesh and Absorption	20
	Chloropicrin absorption	20
	Effect of grinding	21
	Superalite absorption	23
	Phosgene absorption	25
	Choice of mesh for tests	27
<u>IV</u>	<u>Diameter of Layer</u>	28
<u>V</u>	<u>Depth of Layer</u>	
	Chloropicrin Absorption	30
	Relation to mesh	33
	Relation to quality of coal	36
	Absorption of various gases	37,38,39
	Optimum combination of depth of layer and size of particles	40
<u>VI</u>	<u>Appearance and Physical Structure of Charcoal</u>	
	Appearance	47
	Structure	48
	Voids and pores	52
	Size of the pores	54
<u>VII</u>	<u>Gas Content</u>	
	Description of apparatus and method	57
	British charcoal	62
	Astoria charcoal	63
	Analysis of extracted gases	63
	American charcoal of various moisture contents	70
<u>VIII</u>	<u>Apparent Density</u>	

	1. Determination	75
	2. Relation to Mesh	78
	3. Relation to Service Time	84
	Apparent density of crude charcoals	87
	Apparent density of original materials	88
<u>IX</u>	<u>True Density</u>	
	General	90
	True and Apparent Densities	91
<u>X</u>	<u>Moisture</u>	
	1. Determination	92
	2. Relation to Service Time	93
	3. Equilibration	95
	Rate of absorption of moisture	103
	Effect of mesh	106
	4. Rate of Transfer	108
<u>XI</u>	<u>Hardness</u>	
	Relation to Service Time and Apparent Density	112
<u>XII</u>	<u>Pressure</u>	
	Effect of Pressure on Absorption of Gases	114
	Resistance	119
<u>XIII</u>	<u>Aging and Storage</u>	
	Spontaneous combustion	120
	Effect of exposure	121
<u>XIV</u>	<u>Chloropicrin Absorption</u>	
	General	129
	1. In Absence of Moisture	131
	2. In Presence of Moisture	132
	Is there an optimum small moisture content	137
	Effect of humidity	132,141
	Displacement of Chloropicrin by water	143
	3. Temperature Effect	145
	4. Concentration and Rate of Flow	155
	5. Mechanism of the Absorption	158
	Adsorption and absorption	158
	Adsorption of water vapor	171
	Removal of Chloropicrin by air	173
	Permanent retentiveness vs. total capacity	174
	6. Comparative Service Times	177
	7. Absorptive Capacity of Powdered Charcoals	178

CWM 46: Properties of Canister Charcoal, Part II, Austin M. Patterson, Jun 1919

<u>XV</u>	<u>Phosgene Absorption</u>	
	1. In Absence of Moisture	183
	2. In Presence of Moisture	185
	Effect of humidity	185,196
	Effect of moisture in charcoal	185,188
	Effect of aging moist charcoal	194
	3. Temperature Effect	197
	4. Concentration and Rate of Flow	204
	5. Mechanism of the Absorption	205
	Effluent gases	207
	Charcoal and soda lime	208 ff.

XVI	<u>Hydrocyanic Acid</u>	6. Comparison with Chloropicrin (and other gases)	210
	1. Absorption in Standard Tests	212	
	2. Effect of Moisture	213	
	Humidity	213	
	Moisture	214	
	3. Temperature Effect	215	
	4. Effect of Concentration	218	
	5. Mechanism and Comparisons	219	
XVII	<u>Arsine</u>		
	1. Miscellaneous Tests	222	
	2. Effect of Moisture	222	
	3. Effect of Temperature	226	
	4. Mechanism of the Absorption	229	
	5. Comparisons	231	
XVIII	<u>Cyanogen Chloride</u>		
	1. Efficiency Curves	233	
	2. Effect of Moisture	233	
	3. Effect of Temperature	234	
	4. Effect of Concentration	236	
	5. Comparison with Chloropicrin	239	
	Effect of washing	241	
	6. Mechanism of the Absorption	242	
XIX	<u>Superpalite</u>		
	General	244	
	Comparison with other gases	245	
XX	<u>Chlorine</u>		
	General	248	
	Effect of humidity	249	
	Effect of moisture content	250	
	Effect of temperature	251	
	Effect of rate of flow	251	
	Static experiments	252	
XXI	<u>Miscellaneous Gases</u>		
	Acrolein	255	
	Air	255	
	Aniline	256	
	Arsenic Trifluoride	257	
	Benzene	258	
	Carbon Disulfide	259	
	Carbon Monoxide	259	
	Carbon Tetrachloride	259	
	Chloroacetyl Chloride	261	
	Cyanogen	262	
	Cyanogen-Hydrocyanic acid	263	
	Cyanogen Bromide	263	
	Dichloromethyl Ether	264	
	Diphenylchloroarsine	265	
	Ethyl Chloride	266	
	Ethyldichloroarsine	266	
	Gasoline	267	
	Hydrochloric Acid	268	
	Hydrofluoric Acid	268	
	Hydrogen Sulfide	268	

M-1	269
Methyldichoroarsine	271
Mustard Gas	272
Phenyldichloroarsine	273
Sulfur Dichloride	273
Sulfur Dioxide	273
Sulfur Monochloride	275
Xylyl Bromide	275
XXII <u>Heat of Absorption</u>	
1. In Tube Tests	276
2. By the Ice Calorimeter	278
Apparatus	278
Procedure	281
Calculation of Results	283
Materials	284
Results	285
Methyl Alcohol	286
Ethyl Formate	287
Carbon Tetrachloride	287
Ether	287
Carbon Disulfide	288
Chloroform	288
Discussion of Results	288
XXIII <u>Rate of Absorption</u>	
1. Absorption of Dissolved Salts	295
2. Absorption of Gases	296
Lamb and Finkelstein	296
A.E.F. Workers	299
Keyes' Equation	300
Wilson's Equation	301-2
Evacuated Charcoals	302
Lemon's Experiments with Air	306-8
XXIV <u>Revivification and Recuperation</u>	
1. Revivification	309
2. Recuperation	311
XXV <u>Foreign Charcoals</u>	
General	312
1. British Charcoal	312
2. French Charcoal	314
3. German Charcoal	315

CWM 47: Impregnated Charcoals, Part I, Austin M. Patterson, Jun 1919

I <u>Alkali Impregnation</u>	
1. Old German Charcoal	1
2. French Charcoal	11
3. American Experiments	19
Hughes	19
Fuller	20
Wilson and Fuller	21
Wilson	21
Whetzel and Ross	24
Ross	26

	Oberfell and Depew	28
<u>II</u>	<u>Ammonia Impregnation: Larsenite</u>	
	Development of Larsenite	29
	Method of activation	31
	Absorption tests	32
	Quality of base charcoal	33
	Effect of successive treatments	33
	Treatments with ammonia at 400°	33
	Use of pressure in the ammonia treatment	34
	Large scale production	35
	Batch prepared under pressure	38
	Definition	38A
	Effect of moisture	38A
	Comparison with other charcoals	41
	Other results on ammonia impregnation	43
<u>III</u>	<u>Copper Impregnation</u>	
	General	45
	Report of the Joint Committee on Copper Impregnated Charcoals	48
	A. Introduction	48
	The Nitrate Method	48
	The Sulfate Method	49
	The Iron Reduction Method	49
	The Oxide Method	50
	B. Conclusions	50
	Absorptive Efficiency	50
	Operation and Costs	54
	C. Recommendations	57
<u>IV</u>	<u>Whetlerite Preparation</u>	
	1. History	59
	2. Base Charcoals	61
	3. Impregnating Agents	62
	4. Concentration and Temperature of Solutions	64
	5. Acidity	65
	6. Impregnating Methods	66
	7. Time of Soaking	67
	8. Repeated Impregnation	68
	9. Amount of Metal Reacting	68
	10. Washing	69
	11. Drying	72
	12. Additional Impregnating Agents	73
	13. Standard Laboratory Preparation	74
	Whetlerite A	74
	Whetlerite B	75
<u>V</u>	<u>Whetlerite Manufacture</u>	
	1. The Impregnation of the Charcoal	76
	2. The Plating Process	77
	3. The First Bath	77
	4. The Second Bath	78
	5. The Preparation of the Product for the Dryer	78
	6. The Drying Process	78
	7. The Preparation for Shipment	78
<u>VI</u>	<u>Whetlerite Absorption Tests</u>	
	1. Various gases	93

2. Phosgene	99
3. Cyanogen chloride	106
4. Arsine and Hydrocyanic acid	113
5. Hydrocyanic acid and Cyanogen	113
6. Cyanogen bromide	120
7. Dichloromethyl ether	120
8. Hydrofluoric acid	124
9. Methyl dichloroarsine	124
10. Ethyl dichloroarsine	125
11. M-1	127
12. Mustard gas	130
13. Effect of moisture	132

CWM 47: Impregnated Charcoals, Part 2, Austin M. Patterson, Jun 1919

VII	<u>Rankinite and Rankinite A</u>	
1.	Definition	142
2.	Preparation of Rankinite	142
a.	Impregnation of base Dorsite	142
b.	Variation of concentration, etc.	144
c.	Variation of amount of silver nitrate	144
d.	Use of Sulfuric acid	146
e.	Sodium and Ammonium hydroxides	147
f.	Sodium carbonate	148
g.	Effect of 12 per cent cupric oxide	148
h.	Calcining Rankinite	149
i.	Impregnation of unactivated charcoal	150
j.	Washing	151
k.	Impregnation with boiling copper sulfate	151
l.	Absorption from hot and cold solutions	152
m.	Influence of impurities	153
n.	Determining acidity of solutions	154
o.	Best method of impregnation	155
p.	Effect of re-impregnation	156
3.	Manufacture of Rankinite	158
4.	Preparation of Rankinite A	164
a.	Conditions of heating and cooling	164
b.	Change of volume	167
c.	Rise in temperature	167
d.	Effect of varying amounts of copper	169
e.	Effect of quality of the base charcoal	171
f.	Time of calcination	173
g.	Use of Copper sulfate	174
h.	Effect of Sodium chloride	176
5.	Manufacture of Rankinite A	177
a.	From copper nitrate	177
	Recovery of Nitrogen oxides	191
	Requirements for large-scale production	192
b.	From Copper sulfate	196
6.	Absorption tests	199
a.	Comparison with other absorbents	199
b.	Effect of moisture	201
c.	Conduction of heat	205

<u>VIII</u>	<u>Balmerite</u>	
	Definition	208
	Preparation	208
	1. Sizing of raw materials	208
	2. Impregnation	209
	3. Carbonization	209
	4. Air treatment and steam treatment	209
	5. Grinding and screening	210
	Future development	210
<u>IX</u>	<u>Copperized Charcoal and Brownite</u>	
	1. Copperized charcoal	212
	2. Brownite	213
<u>X</u>	<u>Copper Carbonite</u>	
	O'Callaghan, Pipkin and Marston	216
<u>XI</u>	<u>Hexamethylenetetramine Impregnation</u>	
	Whetsel and Ross	222
	"Correlated Data"	222
	Oberfell and Depew	223
	Wilson and Ross	226
<u>XII</u>	<u>New German Charcoal</u>	
	Analysis	230
	Reason for zinc-iron content	231
	Experiments with zinc-treated wood	232
<u>XIII</u>	<u>Liquids to Replace the Water Film</u>	
	Work of Patrick and Helm	237
<u>XIV</u>	<u>Other Impregnations</u>	
	1. Dichromates	241
	2. Permanganates	245
	3. Iodine and its compounds	247
	4. Iron compounds	248
	5. Mercury and its compounds	252
	6. Silver and its compounds	255
	7. Zinc and its compounds	258
	8. Miscellaneous	262

CWM 48: Standard Methods for the Testing of Absorbents for Carbon Monoxide, A.T. Larson, A.R. Jayson and E.C. White, May 1919

Introduction	3
Preparation of Carbon Monoxide	7
Formic Acid Method	7
Oxalic Acid Method	8
Carbon Dioxide Reduction	9
Measurement of Volume	13
Capillary flow meters	13
Dimensions for Capillaries	14
Calibration	16
Measurement of Humidification	19
Wet and Dry Bulb Psychrometer	20
Dew Point Method	22
Hair Hygrometer	24
Vapor Pressure of Water over Sulfuric Acid	26
Humidification of Gases	27

Bead Towers	27
Bead Tower with Air Lift	28
Method of Mixtures	31
Quantitative Estimation of Carbon Monoxide	34
Iodine Pentoxide Method	35
Calorimetric Method	46
Tube Testing	59
Apparatus	59
Standard Tubes	62
Standard Method of Filling	63
Rate of Flow	64
Temperature Control	64
Low Temperature Testing	65
Procedure in Making Tube Tests	67
Record	70
Canister Testing	71
Outline	72
Humidification of Gas	73
Testing Board	75
Testing Board at Belleville Plant	77
Standard Machine Tests	84
Analytical Methods for Carbon Monoxide	89
Cuprous Chloride Method	89
Haldane Method	90
CO ₂ Absorption Methods	92
Iodine Absorption Method	92
Haemoglobin Tests	93
Palladium Chloride Test Papers	94
Physical-chemical Method	94

CWM 49: A Chemical Warfare Glossary, Austin M. Patterson

CWM 50: Pharmacological Data, Part II, Clarence J. West, Jun 1919

Cacodyl	192
Cacodyl Bromide	193
Cacodyl Chloride	194
Cacodyl Cyanide	196
Cacodyl Oxide	200
Capsicum	201
Carbon Disulfide	202
Carbon Monoxide	203
Carbon Oxysulfide (or Carbonyl Sulfide)	205
Carbonyl Bromide	206
Carvacrol	207
Chloral Cyanohydrin	208
Chloretone Ether	209
Chlorine	210
Chloroacetic Acid	217
w-Chloroaceto Catechol	218
Chloroaceto Diphenyl	219
Chloroacetone	220
Chloroacetonitrile	223

Chloroacetophenone	224
Chloroacetophenone Oil	232
Chloroacetotoluone	233
Chloroacetoxyline	235
Chloroacetyl Chloride	237
Chloroacetyl Fluoride	238
Chloroaldehyde Alcoholate	238
Chlorobenzol	239
o-Chlorobenzylbromide	240
p-Chlorobenzyl Bromide	241
o-Chlorochloroacetanilide	243
p-Chloro-w-Chloroacetanilide	244
p-Chloro-w-Chloroacetophenone	245
Chlorodimethyl Ether	246
Chloro Dinitro Benzene	247
B-Chloroethylacetate	248
B-Chloroethyl Chloroformate	249
2-Chloroethyl Chlorosulfonate	250
Chloroethyl Methyl Sulfide	251
2-Chloroethyl Sulfide	252
Chloroethyl Thiocyanate	253
Chloroethyl Thiocyanoacetate	255
Chloroform	256
Chlorinated Mustard Gas	257
Chloroisonitrosoacetone	258
Chloromethylacetate	259
Chloromethyl Butyl Ether	260
Chloromethyl Chloroethyl Ether	261
Chloromethyl Chloroformate	262
Reaction Product of Chlorine and Methyl Chloroformate	264
1-Chloromethyl-1-2-Dichloroethyl Ether	266
4-Chloro-1-Methyl Glyoxaline Chloroxamethyline	267
Chloromethyl Sulfate	268
p-Chloronitrobenzene	269
w-Chloro-5-Nitro-o-Toluonitrile	270
As-Chlorophenoxyarsine	271
o-Chloro Phenylbromacetonitrile	272
4-Chlorophenylbromoacetonitrile	273
m-Chlorophenyl Isocyanate	275
4-Chlorophenylmercaptan	276
Chloropicrin	277
Mixture of Phosgene and Chloropicrin	281
Chloropicrin and Stannic Chloride	284
Chloropropyl Aniline Hydrochloride	285
Chlorosulfonic Acid	286
Chloro-m-Xylylene Bromide	287
Chromyl Chloride	288
Cinnamonnitrile	289
Costa Rica Tree Sap	290
Crotonaldehyde	291
o-Cyanobenzyl Chloride	292
p-Cyanobenzyl Chloride	293
p-Cyanobenzyl Thiocyanate or p-Cyanobenzyl Sulfocyanide	294

Cyano D.M.	295
Cyanogen	296
Cyanogen Bromide	297
Cyanogen Chloride	304
Cyanogen Chloride – Titanium Chloride Complex	312
Cyanogen Iodide	313
Cyanogen Sulfide	314
Cyanuric Chloride	315
Cyclohexylamine	316
Diallyl Sulfate	317
o-Dianisidine	318
Diazomethane	319
a,a-Dibromoethylene	320
Dibromoethyl Selenide	321
Dibromoethyl Sulfide	322
Dibromomethyl Ether	323
Dibromopropyl Sulfide	325
Dibromovinyl Acetate	326
Asym. Dichloroacetone	327
Sym. Dichloroacetone	329
Dichloroacetophenone	332
Dichloroacetylpyrogallol	334
Dichlorobenzyl Bromide	335
Dichlorobenzylmercaptan	336
d,d-Dichlorobutyl Sulfide	337
Dichlorodinitro Benzene (Parazol)	338
a,a-Dichloroethyl Ether	339
Dichloroethyl Selenide	340
Dichlorosulfide (Mustard Gas)	345
The Toxicity of Mustard Gas for Different Species	348
Comparison of Pure and Crude Mustard Gas	358
Toxicity of Mixtures	364
Symptomatology by Inhalation	388
Conclusions	395
Variations of Susceptibility	400

CWM 52: Screening Smokes, Stewart J. Lloyd and Clarence J. West, 25 Oct 1918

I	Introduction	1
	<u>Smoke Production</u>	
	General	2
	Principles of Smoke Production	5
	Size of Smoke Particles	12
	Rate of Settling	18
	Cottrell Smoke Precipitation Apparatus	22
	Classification	24
	Humidity	39
II	<u>Measurements</u>	
	Smoke Box	40
	Tyndall Meter	46
	Units employed	49
	Bomb Pit Measurements	55
III	<u>Zinc Containing Smokes</u>	

Berger Mixture	58
B.M. Standard Mixture	59
Components	63
Smoke Box or Float	78
Smoke Candles	89
Smoke Grenades	96
Stokes' Smoke Shell	100
Livens' Smoke Drum	101
Similar Mixtures	103
Permit Mixtures	104
Zinc Chloride Solution	105
Zinc Chloride in Shells	105
Zinc Oxide in Shells	105
Burning Metallic Zinc	106
<u>IV Phosphorus Smokes</u>	
General	108
Use in Shells and Bombs	110
Naval Smoke Shell	113
Dummy Aerial Bomb Cartridge	116
Training Smoke Bomb for 2" Projector	118
Grenades	121
German Capsules	122
<u>V Chlorosulfonic Acid</u>	
General	123
German Generators	123
Naval Use	129
Smoke Funnel	129
Artillery Shell	129
Corrosion	130
Miscellaneous	130
Manufacture	131
<u>VI Sulfur Trioxide</u>	
Use in Shell and Bombs	135
<u>VII Oleum</u>	
Freezing Point Lowering	140
Corrosion	141
Naval Use	143
Apparatus for Use	144
Nozzles for Spraying	148
Aeroplane Screen	148
Tank Screen	150
Detonation	150
<u>VIII Silicon, Tin, and Titanium Tetrachlorides</u>	
Silicon Tetrachloride	151
Ammonia	152
Smoke Funnel	155
Compressing Medium	155
Specifications	164
Smoke Knapsack	169
Smoke Float	173
Use in Berger Mixture	174
Use in Shells	174
Hand Grenades	176
Specifications	181

	Titanium Tetrachloride	183
	Smoke Funnel	186
	Verdier Apparatus	186
	Shells	186
	Grenades	189
	Berger Mixture	189
	Tin Tetrachloride	190
	Smoke Production	191
	Smoke Grenade	198
	Smoke Funnel	199
	Shells	199
<u>IX</u>	<u>Miscellaneous</u>	
	Ammonia Smokes	201
	Arsenic Chloride	208
	Chlorides and Oxychlorides	208
	Chlorates	209
	Nitrate Mixtures	209
	Fumyl	211
<u>X</u>	<u>Use of Smoke</u>	
	Smoke Tactics	212
	Smoke Producing Substances Available	218
	Quantities required to for a Screen or Barrage	221

**CHEMICAL DEVELOPMENT SECTION
AND
MECHANICAL RESEARCH DEVELOPMENT SECTION
(CDS/MRDS):**

CDS/MRDS: Summary of Achievements, 1917-1918, Chemical Development Section, W. K. Lewis, and Mechanical Research and Development Section, B.B. Fogler [4 copies, also designated CWM 54]

**SMALL SCALE MANUFACTURING SECTION,
CATALYTIC SECTION,
EDITORIAL SECTION,
OFFENSE CHEMICAL RESEARCH SECTION
(SSMS/CS/ES/OCRS):**

SSMS/CS/ES/OCRS: Summary of Achievements, 1917-1918, Small Scale Manufacturing Section, Catalytic Section, Editorial Section, Offense Chemical Research Section [also designated CWM 55]

Small Scale Manufacturing Section	1
Mustard Gas	2
Brombenzyl Cyanide	2
Butyl Mercaptan	3
Chloroacetophenone (production)	3
Chloroacetic Acid	3
Chloroacetyl Chloride	3
Chloroacetophenone (purification)	4

Diphenylchloroarsine	4
Nitrogen tetroxide	4
Dichloromethylarsine	5
D.M.	5
Hydrocyanic Acid	5
Cyanogen Chloride	5
Arsenic Trichloride	6
Cyanogen Bromide	6
Arsine (Liquid)	6
Aluminum Chloride	6
Magnesium Arsenide	6
Smoke Mixture	7
Superpalite	7
Hydrofluoric Acid (anhydrous)	7
Strontium Chlorate	7
Aluminum Arsenide	7
Arsenic Trifluoride	7
Kendallite	8
Phosgene purification	8
Absolute Alcohol	8
Sodium hydroxide, alcohol free	8
Nature of work	
Production	9
Construction	9
Storage and Shipping	9
Power	9
Clerical	9
Reports	9
Safety	9
Catalytic Section	10
Synthetic Charcoal	10
Laminated Charcoal from Paper and Cloth	14
Fluorine	15
Thiosuperpalite	22
Superpalite	23
Tetrachloroethylene	28
Tetrachlorodinitroethane	31
Bromoacetone	32
Oxidation of Acetaldehyde	33
Smokes	36
Permeability Phenomena	37
Editorial Section	38
Offense Chemical Research Section	41
Organic Research Unit No. 1	46
Organic Research Unit No. 2	54
Organic Research Unit No. 3	57
Inorganic Unit	65
Research Analytical Unit	71
Control Analytical Unit	74
Units at Field Stations	
Johns Hopkins University Unit	77
Princeton Unit	80
Bryn Mawr Unit	81
Worcester Polytechnic Unit	81

American University Technical Reports

Ohio State Unit	82
Yale Unit	82
Columbia Unit	82

MECHANICAL RESEARCH SECTION (MRS):

MRS 1: Mechanical Research Section, Reports 1-11 (21 Sep 17-15 Feb 18), H.H. Clark (mask and canister work)

1. Report of Mechanical Researches: Clark, 9/21/17	1
2. Report of Mechanical Researches: Clark, 10/1/17	5
3. Report of Mechanical Researches: Clark, 10/13/17	9
4. Report of Mechanical Researches: Clark, 11/1/17	16
5. Report of Mechanical Researches: Clark, 11/15/17	28
6. Report of Mechanical Researches: Clark, 12/1/17	41
7. Report of Mechanical Researches: Clark, 12/15/17	66
8. Report of Mechanical Researches: Clark, 12/31/17	75
9. Report of Mechanical Researches: Clark, 1/15/18	86
10. Report of Mechanical Researches: Clark, 2/5/18	95
11. Report of Mechanical Researches: Clark, 2/15/18	108

MRS 2: Mechanical Research Section, Reports 12-17, H.H. Clark (mask and canister work)[includes Specs for the American Tissot]

12. Main Report: Clark	2
13. Development of American Tissot Type Gas Mask: Wagenhorst, Clark and Meckley	7
14. Development of a Nose Stopper for Negro Soldiers: Clark	49
15. General Report of Smoke Filter Work: Raisig	55
16. Method for Comparing the Transparency of Material used for Gas Mask Lenses: Clark	78
17. Resistance of Standard Box Respirator: Meckley and Sam Stone	86

MRS 3: Mechanical Research Section, Reports 18-28, H.H. Clark (mask and canister work)

18. Main Report of this Division: Clark	2
19. Development of the Head Canister Mask: Clark and Weinert	5
20. Development of Air Lined Helmet and Suit for Workmen in Poison Gas Factories: Lambert	17
21. Method for Determining the Comparative Resistance of Gas Mask Lenses to Scratching: Clark, Little and Stone	24
22. Emergency Canister for Protection against Chlorine in Submarines: Raisig, Gaines and Sprague	40
23. Main Report No. 2 of this Division: Clark	49
24. Development of Clark – Raisig Internal Smoke Filter: Clark, Raisig, Kynz and Canfield	51
25. Development of Tissot Type Mask Suit for Protection of Workmen in Poison Gas Factories: Lambert	56
26. Three Types of Canisters for Absorbing Carbon Monoxide:	

Clark, Lambert and Sprague	62
27. Preliminary Report on the Development of the Clark – Raisig Smoke Filter Cartridge	80
28. Method of Comparing Toughness of Nibs of Box Respirator Mouth Pieces: Little	91

MECHANICAL RESEARCH AND DEVELOPMENT SECTION (MRD):

MRD 1: Gas Masks (Reports 1-13)

1. Comparison of Facepieces for Masks : Fogler	1
2. Modified Tissot Mask (Made by Ravenna Rubber Co.) :	
Abraham	4
3. Howe Type Tissot Mask (Partial Report #1) : Abraham	6
4. Howe Type Tissot Mask (Partial Report #2) : Abraham	8
5. Development of the Miller Type Tissot Mask : Miller	10
6. Development of a Non-Dimming Gas Mask : Daniels, Buttolph, Brawley, Glancey, & Miller	29
7. Report on the Use of Telephone with the American Tissot Mask :	
Kendrick	96
8. Oxygen Masks for Aviators : Abraham	104
9. Gas Defense Service Horse Mask : Giles	109
10. Horse Mask : Giles	113
11. Gas Masks for Dogs : Abraham	115
12. Goodrich Lakeside Mask and Carrier (Partial Report #1) :	
Miller	120
13. Development of the Goodrich-Lakeside Mask and Carrier :	
Miller	125

MRD 2: Canisters (Reports 14-27)

14. Check Valve Guard – Concussion Tests of Sheet Metal Check Valve Guards : Heffner	1
15. Comparison of Canisters under Consideration July 8, 1918 :	
Fogler	4
16. 11-H. Canister Springs. Examination of Springs now in Use. Development of Methods for Testing. Specifications for Size, Shape, Strength, etc. : Little	11
17. 11-M. Development of 50 mm Canister. Partial Report No. 1: Canfield	14
17A. 11-M. Development of 50 mm Canister. Partial Report No. 2: Canfield & Runals	18
18. Lumber Wagon Tests on Box Respirator Canisters	23
19. Effect of Canisters of Varying Resistance upon the Physical Efficiency of Men. Field Tests with Box Respirators.	31
20. 11-R. Flat Type Filter, Part 1: Runals	50
20A. 11-R. Flat Type Filter, Part 2: Runals and Sprague	54
21. Improved Rescue Canister : Sprague	60
22. Vest Pocket Emergency Canister : Sprague	63
23. Development of the Army Canister and the Application of	

American University Technical Reports

Smoke Filters Thereto at the American University Experiment Station : Lambert	69
24. Development of the Army Carbon Monoxide Absorbing Canister : Reymond	85
25. Method of Applying Wrapped Paper Filters to Logan Canisters: Horton	91
26. 11-V. Leakage and Resistance of Check Valves for Logan Canisters during "Ageing" Tests on Intermittent Canister Testing Machine: Heffner	94
27. Final Report. Development of the Canister and Carrier for the Navy Head Mask and the Application of the Smoke Filter Thereto: Gaines	98

MRD 3: Filters (Reports 28-44)[sample felt materials]

28. Title Unknown	1
29. Development of Dustless Packing : Runals, Marriett, and Prozan	6
30. Report on Formation of Dust in Canisters that can be drawn into Masks when in Use : Abbott	14
31. Development of Dustless Packing – Final Report : Sprague, Marriett, Prozan	18
32. Efficiency of Doughnut Internal Filters when Equilibrated with 90% Relative Humidity : Runals	27
33. Comparative Test of Papers used in Doughnut Internal Filter : Runals and Beatson	39
34. Development of Smoke Filtering Paper : Wright	71
35. Partial Report #4. Development of Smoke Filtering Paper. Trip to Neenah and Madison, Wisconsin : Wright	77
36. Report of Trip to Albemarle Paper Manufacturing Company, Richmond, Virginia : Wright	84
37. Trip to West Conshohocken, PA; Bridgeport, PA; Darby, PA : Wright	89
38. Development of Smoke Filter Paper : Wright	92
39. Partial Report #6. Development of Smoke Filter Paper. Trip to Philadelphia and Wilmington : Wright	97
40. Partial Report #7. Development of Smoke Filter Paper. Trip to Philadelphia and Wilmington : Wright	101
41. Development of Smoke Filter Paper : Wright	103
42. Photographic Work on Crepe Paper for Smoke Pad : Curtis and Harding	104
43. Tests to Determine the Efficiency of the Long Island Laboratory Canister against G-25 and G-52 : Runals	108
44. Development of the Accordion Filter Canister : Lambert	139

MRD 5: Protective Clothing (Reports 69-92)[mask, detector]

69. An Impervious Overall Suit for Protection against HS : Abraham and Giles	1
70. Semi-Permeable Protective Suit for Factory Use : Abraham	14
71. Pyroxylin Coated Gloves, Partial Report #1 : Abraham	23
72. Coated Gloves for Protection against G-34 : Abraham and Carey	25
73. Field Tests of Protective Suits against G-34 : Abraham	37

74. Rubber Boots as Protection against G-34	39
75. Protective Horse Boots : J.D. Giles	41
76. Protective Horse Boots, Final Report : Haynes and Giles	52
77. An Impervious Boot and Pad to Protect Horses' Hoofs and Legs against HS : Giles	67
78. Method of Conducting Friction Test on Adhesive Tape, P.R. #1: Abraham	76
79. Repair Tape for Gas Masks (Final Report) : Abraham	78
80. Corrosion of Nose Clip Springs – Sherardized Springs, Partial Report #2 : Walther	81
81. Corrosion of Nose Clip Springs – Sherardized Springs, Partial Report #3 : Walther	83
82. Corrosion of Nose Clip Springs – Sherardized and Enameled Springs, Partial Report #4 : Walther	86
83. Canister and Nose Spring Corrosion Tests : Rundlett	89
84. Knapsack Spring Corrosion – Sherardized Springs, Partial Report #1 : Walther	91
85. Knapsack Spring Corrosion – Sherardized and Enameled Springs, Partial Report #2 : Walther	93
86. Corrosion Tests on "Lift the Dot" Snaps : Carlisle	96
87. Corrosion Tests on Adjustable Harness Buckles : Carlisle	98
88. Corrosion Test on Flutter Guard Coated with Electric Zinc, Partial Report #1 : Graham	101
89. Corrosion Tests on Buckle Springs and Suggested Material, Partial Report #1 : Heffner	102
90. Mechanical Development of Lantern Type G-34 Detector : Reymond	104
91. Elastic Webbing, Partial Report #1 : Abraham	111
92. Design and Standardization of Chest and Tools for Special Gas and Flame Troops, Partial Report #1 : T.D. Stone and W.S. Giles	115

MRD 6: Pyrotechnic Devices (Reports 93-101)[shells, cylinders, Livens, projectiles, flame bayonets]

93. Submarine Recognition Signal : Abbott et al	1
94. Development of a Float Light for Airplanes : Gowdy, Asire, Walther	119
95. Float Light for Airplanes : Asire	130
96. Development of a Seal for Enamel Lined Shell Composition Gaskets : Asire	133
97. Development of a Seal for Enamel Lined Shell : Asire	145
98. Mobile Toxic Gas Cylinder : Abbott	149
98a. Mobile Toxic Gas Cylinder Part II	
99. Arsine Livens Projectile : Abbott	211
100. Flaming Bayonet : Asire	214
101. Development of Seal for Enamel Lined Shell : Asire	300

MRD 7: Papers (Reports 102-111)[canisters and filters]

102. Comparison of Pressure Drop as Determined from Different Sized Flanges and Rates of Flow : Bovard & Hunt	1
103. Tentative Study of Paper for the Accordion Filter and	

Development of A-35 Paper : Bovard	4
104. The Development of a Paper for the Accordion Filter	20
105. A Portable Pressure Drop Apparatus for Mill Use:	
Bovard :	28
106. Estimate of the Amount of French Noils and Shear Flock Wool Available for Making Smoke Filter Paper for Gas Masks	31
107. First Run at the Albemarle Paper Manufacturing Company :	
Bovard	37
108. Development of a Wool Paper for Filtering Smoke: Bovard	53
109. Work at the Clapp Laboratory on the Use of Celite in a Paper for Filtering Smokes : Bovard	101
110. Results of Correspondence with Paper Mills to Secure a Paper Suitable for Filtering Smokes	108
111. Mental and Neuro-Muscular Effects of Gas Mask Tenancy	118

MRD 8: Reports 112-117, [cylinders, detectors, shells, Stokes]

112. Toxic Gas Cylinder and Gas Replacement Set : Runz & Siegle	1
113. Field Gas Sampling : Auerswald	11
114. H.E. Toxic Shell Capsule : Abbott	31
115. 3" Toxic Stokes Shell for G-76 : Abbott & Lekberg	32
116. 4" Navy Marker Shell : Lekberg & Abbott	34
117. Field Gas Test Apparatus : Abbott	41

DEFENSE CHEMICAL RESEARCH SECTION (DR):

DR 1: Eyepiece Unit Reports, Part I (Reports 1-19), Arthur B. Lamb

1. Report on Eyepieces : Carleton	1
2. Report on Eyepiece Problems : Carleton	8
3. Report on Eyepiece Problems : Carleton	15
4. Report on Eyepiece Problems : Carleton	27
5. Removal of Surface Scratches by "Ashing and Polishing" (Buffing) : Carleton	40
6. Re-surfacing of Scratched Eyepieces by Press Polishing : Carleton	44
7. Application of an Antidimmer to the Dimmed Eyepiece while Wearing the Mask in Presence of Xylyl Bromide Vapor : Hughes	48
8. Research on Eyepieces to March 16, 1918 : Carleton	50
9. Report on the Behavior of Reduced Nitrate and Impregnated Nitrate, Prepared by the E.I. DuPont De Nemours Company : Nichols	56
10. Impregnation of Hydrolyzed Cellulose Acetate with Saponified Sulphonated Corn Oil : Nichols	59A
11. Summary of the Work on Antidimming Preparations (By Cooperating Laboratories : Carleton) (By American University : Woodside)	62
12. Test of Antidimming Compound : Vawter	75
13. The Construction of Vacuum Cell Eyepieces for Gas Masks :	

American University Technical Reports

Kraus & Buttolph	77
14. Summary of Eyepiece Situation : Carleton	80
15. Tests of Antidimming Compositions at Camp Devens, Ayer, Massachusetts, April 8, 9, 10, 1918 : Carleton & Cummings	94
16. Some Methods of Determining the Defining Power of Gas Mask Eyepieces : Carleton & Keller	101
17. Some Effects of Decreased Vision Due to Gas Mask Eyepieces : Carleton & Keller	109
18. Prevention of Dimming of Eyepieces in Masks by Special Mechanical Construction : Argo & Lamb	119
19. Sulphonation of Castor Oil : Hughes	141

DR 1: Eyepiece Unit Reports, Part II (Reports 20-32), Arthur B. Lamb

20. Tests of Nondimming Eyepieces at Camp Devens April 11 & 12, 1918 : Carleton & Cummings	146
21. Nondimming Cellulose Eyepieces (A – Cellulose Films from Cellulose Nitrate) (B – Cellulose Films from Viscose : Carleton) (C – Cellulose Films from Cellulose Acetate : Nichols)	154
22. Field of Vision as Affected by a Gas Mask : Carleton & Keller	170
23. Gas Mask Eyepiece Investigation : MacNaughleer & Cummings	177
24. Report on Anti-Dim Preparations : Carleton	179
25. Measurement of Mask Resistances : Carleton & Richardson	182
26. Report on Eyepieces : Carleton	192
27. Prevention of Dimming of Eyepieces in Masks of Special Mechanical Construction; Part II, Ventilated Eyepieces : Carleton & Richardson	199
28. Some Effects of Decreased Illumination on the Use of Gas Mask Eyepieces : Carleton & Keller	207A
29. Moisture Absorption by Non-dimming Eyepieces and Anti-dimming Compounds A – Rate of Moisture Absorption of Non-dimming Eyepieces and their Rate of Recovery : Carleton & Nichols B – Absorption of Moisture from a Saturated Atmosphere of Water Vapor by Anti-dimming Compounds : Carleton & Nichols	215
30. Eyepieces; Sept. 1918 : Carleton	233
31. A Search for a Non-dimming Glass Suitable for Eyepieces in Gas Masks : Buttolph & Stockbarger	235
32. Anti-Dimming Preparations for Gas Masks : Holmes, Oberlin College, Oberlin, OH	261

DR 3: Analytical Reports (Reports 44-87), Arthur B. Lamb [detectors]

44. Report on a Method of Analyzing Sodium Manganate Solution: Welsh	1
45. Study of Methods for the Detection, Analysis, and Absorption of G-55 : Chamberlain	4
46. Analysis of a Sample of Hexamethylene Tetramine : Welsh	6
47. Method of Analysis of Liquid G-178 : Winklemann & Clifford	7
48. Method for determining G-178 in air : Winklemann & Clifford	9

49. Report on Analysis of Meal Powder – Problem A-1-8 : Welsh	11
50. Revised methods of analysis for Sodium Permanganate – Solutions including methods for NaMnO ₄ , Na ₂ MnO ₄ , MnO ₂ , NaClO, NaClO ₃ , NaOH, Na ₂ CO ₃ , NaHCO ₃ , Na ₂ SO ₄ , and NaCl : Wilson and Parsons	12
51. Analysis of Rubber Samples : Clifford	27A
52. Analysis of Arsine for Captain Brinton (by Carl M. Tausig) (This report missing)	
53. Determination of Small Amounts of G-178 in Air : Fuller	28
54. Analysis of Kendallite for Free Hydrocyanic acid and Chlorine : Clifford	30
55. Analysis of Sample of G-25 According to Specifications : Clifford and May	33
56. Methods of Analysis and Testing of Raw Materials for British Cement Granules : Wilson and Whetzel	36
57. Complete Report on A-1-4 : Brinton	47
58. Analysis of Solution for Impregnating Horse Respirators : Crockett	49
59. Analysis of Sample of Sodium Cyanide : Clifford	53
60. Analysis of S-28 : Roberts	55
61. Ferromanganese : Finck	58
62. (a) Mn and Si in Ferro-Manganese : Hammond (b) Carbon in Ferro-Manganese : Parker (c) Analysis of Iron in Ferro-Manganese	60 62 63
63. Method of Determining the Concentration of G-67 in Alcoholic Solution : Conant and Hammond	66
64. Method of Determining G-34 in Alcoholic Solutions : Conant and Clifford	67
65. Analytical Method for Hexamethylenetetramine : Finck and May	69
66. Analysis of Superelite for Chlorine – Problem A1-6 : Clifford	71
67. Analysis of Markleed Green Ash (Barium Manganate) : Parsons and Chisholm	76
68. Analytical Method for BaMnO ₄ Fusions : Parsons and Chisholm	77
69. Analysis of Anhydrous Hydrofluoric acid : Rosenthal	81
70. Analysis of A-4 for G-25 : Roberts	83
71. Alcoholic Sulphite Method of Analysis of G-25 : Roberts	86
72. Method for the Analysis of Double Fluorides of Lead and Sodium : Brinton and Hammond	89
73. The Determination of Small Amounts of H ₂ O in G-25 : Brinton and Roberts	91
74. Procedure for Analysis of N ₂ O ₄ : Rosenthal	93
75. Analysis of N ₂ O ₄ for HNO ₃ Content : Smyth and Rosenthal	95
76. Method of Analysis for Spent Hoolamite : Bray and Krivian	97
77. Methods of Analysis for Chlorine, Phosgene, Hydrocyanide, and Chloropicrin (this report missing)	
78. Method for the Analysis of Mixtures of G-178 and Hydrogen Cyanide : Brinton and Crockett	103
79. Abstracts of Methods of Analysis used in Research Analytical Section – Offense Chemical Research	105
80. Analysis of Acetic Acid : Adams	110
81. Methods of Testing Soda Lime : Wilson	112

American University Technical Reports

82. A New Method for the Determination of G-34 in the presence of G-52 : Brinton and Schrock	121
83. Examination of Samples of Thio Carbanilid – Problem 004-31 : Adams and Graebe	128
84. The Determination of Nitrogen in Nitronaphthalenes : Brinton, Crockett, and Merkel	129
85. Liquid Ammonia-Sodium Method for Halogens in Organic Compounds. Formation of Cyanide and Method to Remove from the Solution : Clifford	147
86. Application of Winkleman's Sodium Peroxide – Phenodi-sulphonic Acid Method to the Determination of Chloropicrin in the presence of Phosgene and Free Chlorine : Brinton and Crockett	167
87. The Determination of Carbon Tetrachloride in Air Mixtures : Brinton and Hammond	177

DR 4: Protective Clothing (Reports 88-102), Arthur B. Lamb [masks]

88. Report on an Overall Suit for Protection against G-34 Vapor : Hill and Members of Protective Clothing Unit	1
89. Choice of Fabrics for the Gas Mask : Johnson	8
90. Report on Oils for French Masks : Patrick	23
91. Evaporation of Water through Impregnated Clothes Treated for G-34 Protection : Wilson, Fuller, & Crocker	25
92. Progress Report on Protective Underclothing : Hill	28
93. Report of Progress on Protective Underclothing against G-34 Vapor : Hill, Crocker, Cheronis, Noble, Witteveen, & Grabowski	33
94. Conference on Protective Underwear, 7/8/1918	43
95. Progress Report of the Committee on Protective Underclothing against G-34 : Wilson	45
96. Synopsis of Tests on "Perbromel" : Hill	49
97. Synopsis of the Work of the Protective Clothing Unit. Overall Fighting Suit : Hill	54
98. Emulsoid Overall Fighting Suit for Protection against G-34 Vapor : Hill and Members of the Protective Clothing Unit	56
99. Choice of Fabrics for the Gas Mask. Appendix Supplementary to Previous Report : Johnston and Perrott	72
100. Removal of G-34 from Clothing by Accelerated Hydrolysis : Wilson, Schur, Thatcher, and Aronson	80
101. Data on Emulsoid Fighting Suit : Hill	113
102. Report on Factory Made Samples of the Emulsoid Overall Fighting Suit : Hill & Members of the Protective Clothing Unit	117

DR 7: Special Absorbents (Reports 115-120), Arthur B. Lamb

115. Silicic Acid Gel as an Absorbent for Gases : Patrick	1
116. Report on Future Possible Chemical Absorbents : Wilson	4
117. Second Progress Report on Possible Future Chemical Absorbents : Wilson	20
118. Report on Silicic Acid Gel : Patrick	27
119. Synopsis of Experimental Work on Silica Gel :	

American University Technical Reports

Davis and McGavack	31
120. Method of Testing Absorbents against SO ₂ : Wilson and Neifert	47

DR 8: Efficiency of Absorbents (Reports 121-135), Arthur B. Lamb

121. Efficiency of Various Absorbents against Hydrofluoric acid: Parsons & Fuller	1
122. Investigation of Efficiency of Various Absorbents against G-178 : Fuller	4
123. Absorption of AsF ₃ by Present Canister Materials : Wilson, Fuller, & Waterhouse	5
124. Efficiency of Present and Future Canister Materials against BrCN : Wilson, Fuller & Waterhouse	11
125. Report on G-178 Absorbents : Wilson and Fuller	16
126. Efficiency of Present and Future Canister Materials against Methyl Dichlor Arsine : Wilson and Yant	19
127. Efficiency of the Present and Future Canister Materials against G235 : Wilson, Yant and Notestein	23
128. Efficiency of Present and Future Canister Materials against G-34 : Wilson & Yant	34
129. Efficiency of Present and Future Canister Materials against G-319 : Wilson & Yant	45
130. Efficiency of the Present and Future Canister Materials against L-1 : Wilson & Yant	53
131. G-178 Efficiency on Various Charcoals and Whetlerite : Wilson	66
132. Effect of Depth of Layer upon Efficiency of Different Absorbents against Standard Testing Gases : Wilson, Wolfe, and Chisholm	74
133. The Effect of Mesh and Depth of Layer of Absorbent on G-52 Efficiency. Preliminary Report : Wilson, Wolfe, & Atkinson	85
134. Qualitative Indicators for Cyanogen Chloride, Superpalite, and Phosgene : Wilson and Siegel	100
135. Best Arrangement of Different Meshes of Absorbents for Maximum Efficiency : Wilson, Rosengren, & Chisholm	112

DR 9: Arsine (Reports 136-145), Arthur B. Lamb

136. Preliminary Toxicity Test on Arsine : Lewis	1
137. Second Preliminary Report on the Absorption of Gas G-7 : Lewis	7
138. Third Preliminary Report on Gas G-7 : Stewart, Scalione and Merrill	14
139. Fourth Report on the Gas G-7 Experimental Work : Scalione and Merrill	26
140. Fifth Report on the Gas G-7 Experimental Work : Scalione and Merrill	35
141. Preparation of Copper Oxide	38
142. Report on CuO and CuO + AgNO Tested as an Absorbent for Cl ₂ Gas : Scalione and Merrill	39
143. Hydrated Cupric Oxide as an Absorbent : Wilson and Fuller	40

144. Report NO-II on Dissolving and Stabilizing G-7 : Scalione and Merrill	52
145. Report on the Practicability of Producing G-7 and the Compounds of G-7 on a Commercial Basis : Kraus	56

DR 10: Charcoal, Part I (Reports 146-164)

146. Substitutes for the Coconut as Raw Material for Charcoal	1
147. Report on Charcoal for Dr. Lamb	5
148. Second Report on Raw Materials for Charcoal	11
149. An investigation showing the Rate at which Chloropicrin is driven from Charcoal by Sulfur Dioxide Charged Air	13
150. The Distribution of Absorbed Gases in the Absorption Tubes when Charcoal is tested for Absorption Power	15
151. Air Separation of Activated Charcoal : Rollason	18
152. The Velocity of Gases necessary to cause Channeling and Gas Pockets in a Vertical Tube of Charcoal	21
153. Additional Heat Treatment of Steam Treated Charcoal	24
154. The Coconut Industry of Tropical America	25A
155. The Production of Coconut Oil and Copra in the Philippine Islands	25E
156. The Coconut Industry of the Philippine Islands	26
157. A Report on the possibilities of distilling Coconut Hulls for Charcoal in the Philippine Islands : Rollason	29
158. A Report on progress of Whetlerite "A" including Canister Test Results : Wilson	33
159. The Adsorption of G-25 by Prepared Charcoals : Helm and Patrick	37
160. A Study of the Water Content of Plain and Impregnated Charcoals at Equilibrium with Air of different Humidities : Baumgardner	48A
161. The Heat of Adsorption of Vapors by Charcoal : A. Sprague Coolidge	49
162. Preliminary Report on Balmerite : McNeil and Balmer	66A
163. Method of Obtaining a Uniform Sample of Charcoal or Granules : Wilson and Wolfe	67
164. Summary of the Work on the Impregnation of Charcoals : Whetzel and Ross	74

DR 10: Charcoal, Part II (Reports 165-179), Arthur B. Lamb

165. The Utilization of Coconut Fines as an Absorbent : N.K. Chaney	91
166. The Effect of Humidity on the Absorption of G-52 by Charcoal Whetlerite : Wilson, Wolfe and Chisholm	94
167. Validity of the Keyes' Equation for the Absorption of Gases by Charcoal and Rubber : Wilson	106
168. Notes on Standard G-25 Test for Charcoal : Wilson and Kelley	125
169. Suggested Equipment for Whetlerite Plant : McNeil, Balmert and Brown	130
170. General Production of Carbon for Absorption of Chlorine 1.000 : Moore	135

171. Adsorption of Air on Charcoal : T.E. Doubt	146
172. Report on visit to the Plant of the Mitchell Lime Co., Mitchell, Indiana : Johnston	148
173. Velocity of Adsorption of G-25 by A-4 : Lamb and Finkelstein	151
174. Effect of Time of Heating at 400°C, in Closed Crucible upon Activity of Rankinite "A" : (Research) M. Pipkin, (Report) L.C. Lamb	156
175. Activation of special Copper Carbonate by different methods of treatment	160
176. Technical Report of Research Laboratory, Research Division, C.W.S., National Carbon Co., Cleveland, Ohio	170
177. Effect of N ₂ , H ₂ , CO ₂ , SO ₂ , O ₂ , O ₃ and Air on the G-7, G-25, and G-52 activity of Dorsite : Johnston and O'Callaghan	173
178. The Effect of Presence of Sodium Chloride in Dorsite on its use for manufacture of Rankinite "A" : (Research) – Pvt. P. Learoyd, (Report) – Pvt. L.C. Lamb	177
179. The Construction and Operation of Dorsite Furnaces : J.R. Silver, Jr.	180

DR 11: General Reports on Charcoal (Reports 180-197), N.K. Chaney

180. Construction Details and Operating Notes on Electric Furnace for Charcoal Treatment : Chillas	1
181. First Report Process of Treating Charcoal for Absorption Purposes : National Carbon Co.	7
182. Second General Report on Absorptive Charcoal for Gases : Chaney	12
183. Third General Report upon Absorptive Charcoal for Gases : Chaney	19
184. Fourth Report on Absorptive Charcoal for Gases : Chaney	29
185. Fifth General Report on Absorptive Charcoals. Testing : Chaney	48
186. Sixth General Report upon Absorptive Charcoals for Gases : Chaney	61
187. Seventh General Report upon Absorptive Charcoal for Gases : Chaney	81
188. Eighth General Report upon Absorptive Charcoal for Gases : Chaney	95
189. Ninth General Report on Absorptive Charcoal for Gases : Chaney	103
190. Ninth General Report – Part II	116
191. Tenth General Report. A study of the relation between the real and apparent densities of Charcoal and its absorptive power for Gases : Chaney & Appmann	119
192. Eleventh General Report on Absorptive Charcoals for Gases : Chaney	138
193. Twelfth General Report. Characteristics of G-25, and Water Adsorption in Charcoal : Chaney	148
194. Thirteenth General Report on Absorptive Charcoals for Gases : Chaney & Wilson	154
195. Fourteenth General Report. Relation between "Break Point" and "Saturation Point" and General Theory of the Absorption of Gases by Carbon : Chaney	171

American University Technical Reports

196. Fifteenth Report. German Charcoal. Its properties and possible methods of preparation : Chaney, Wilson, and Few	191
197. Sixteenth General Report. Relation of Gas Treating to the Activation of Charcoal : Chaney	206

DR 12: Cloud Gases (Reports 197-203), Arthur B. Lamb

197. First General Report on Cloud Gases : Chaney	1
198. Second General Report on Gas Cloud Work. Gas Cloud Generator and Apparatus for determining a "Break Point" with G-76 Tests : Ward & Bosman	5
199. Third Report upon Cloud Gases : Chaney & Bosman	9
200. Fourth Report on Cloud Gases. Generation and Analysis of G-76 by Electrical Methods : Chaney & Bosman	12
201. Fifth General Report on Cloud Gases. Part I : Ball & McGrath	16
202. Fifth General Report on Cloud Gases. Part II : Chaney	46
203. Sixth General Report on Cloud Gases. Mechanics of Smoke Filtration : Ball, McGrath, Holton, Lukens, and Chaney	61

DR 13: Protective Ointments (Reports 204-211), Arthur B. Lamb [decon]

204. Progress Report on the Destruction of G-34: Wilson and Fuller	1
205. Progress Report on Protective Ointments against G-34: Wilson and Fuller	16
206. Results of Tests with Ointments for Protection against G-34: Wilson and Fuller	33
207. Third Progress Report on Protective Ointment: Wilson and Fuller	34
208. Conference on Protective Ointments held in Colonel Lamb's Office, Oct. 16 th .	48
209. Conference on Protective Ointments for Mustard Gas July 16, 1918	50
210. General Report on Protective Ointments against G-34	53
211. Report of Committee on Ointment #66	137

DR 14: Mustard Gas, Part I (Reports 212-232), Arthur B. Lamb [detectors]

212. Preliminary Report on Apparatus for Testing Sensitivity of Various Organisms to Small Amounts of Poisonous Gases : Wilson	1
213. A New Method for the Quantitative Determination of G-34 in Air: Wilson, Fuller, and Smith	4
214. First Report on the Detection of Toxic Gases by Animal Organisms: Parker and Bray	11
215. Report on the Detection of Certain Gases by Means of Organisms (Animal): Parker and Bray	15
216. Outline of Proposed Large Scale Field Experiments on Persistency of G-34: Carleton	30
217. Use of ICl and ICl ₃ for detecting small amounts of G-34: Fuller and Waterhouse	34
218. Conference on Lantern for G-34 detection in the field	37

American University Technical Reports

219. Progress Report on the Hydrolysis of G-34 (Especially by the Use of Turkey Red Oil) : Wilson, Fuller, and Schur	38
220. Fall in concentration of G-34 in air over sprayed areas	44A
221. Stability of Bleaching Powder Lamp Black Mixtures, Preliminary Report : Wilson and Parsons	45
222. Report on the Use of Potassium Platinic Iodide as indicator for G-34: Bray	49
223. Report of Field Experiments on persistency of G-34: Carleton	53
224. Report on casualties caused on Weaver farm : Wilson	65
225. The Copper Flame test for G-34 : Carleton and Nichols	72
226. The Detection of Toxic Gases by Means of Organisms	91
227. Preliminary Report on Extraction of G-34 from Soil: Carleton and Craig	131A
228. The Detection of Toxic Gases by Means of Organisms (Snails): Scoville	132
229. Masking Effect of Butyl Mercaptan on Odor of G-34: Carleton and Wilson	152
230. The Reaction of Silver Perchlorate with G-34 in Non-Aqueous Solvents: Hill and Crocker	162
231. Aromatic Iodide-Dichlorides and Iodoso-Compounds as Reagents for G-34 : Hill, Crocker, and Grabouski	170
232. Chloramines of Sulphonic Acids as Reagents for G-34 : Hill and Crocker	180

DR 14: Mustard Gas, Part II (Reports 233-239), Arthur B. Lamb

233. The Perhalogenated Phenols as Reagents for G-34 : Hill, Crocker, and Grabouski	198
234. Nephelometric Determination of G-34 in Air Samples : Carleton and Meldrum	231
235. Halogen-Amines of Carboxy-Acids as Reagents for G-34 : Hill, Crocker, and Grabowski	274
236. Notes upon the Chemical Theory of Ointment Protection against Mustard Gas by Heavy Metal Soaps: Chisholm	285
237. Field Experiments on Persistency of War Gases : Carleton	315
238. Method of Testing Bleaching Powder Mixture for Safety in Shipping : Wilson, Ward, and Kendall	382
239. Study of Perchlorate and its Reaction with Mustard Gas	385

DR 15: Soda Lime and Permanganate in General, Part I (Reports 240-259), Arthur B. Lamb

240. Report of Progress on Soda Lime: Wilson	1
241. Report of Progress of Work on Soda Lime at National Carbon Company, Cleveland, Ohio: Carleton and Wright	5
242. Outline of Soda Lime Work now in Progress : Wilson	7
243. Work on A25 and Allied Problems: Wilson	15
244. Report of Progress on A25 and Allied Problems: Wilson	28
245. Method of Testing Hardness of Soda Lime: McNeil	34
246. The Oxidation of Sodium Manganate with Chlorine: Wilson	36
247. The Effect of the Size of A25B Granules on their Absorption Efficiencies: Wilson	42

American University Technical Reports

248. Recovery of A-34 from A-25-B Fines : McNeil and Mason	51
249. Binding Agents for Soda Lime: Whetzel	59
250. Activation of Soda Lime: Wilson	86
251. Report on Recent A-25-B Difficulties at Astoria: Wilson	93
252. Preliminary Report on the Manufacture of Calcium Permanganate: Wilson and Parsons	107
253. Precipitation of Sulfates and Carbonates from Mag Mix Solution: McNeil and Simon	114
254. Effect of Moisture on Chemical Efficiency and Production of A25B made at Columbia University: McNeil and Freudenheim	118
255. Effect of Moisture on Hardness of A25B: McNeil and Roff	121
256. Loss in Total Existing Power in the Manufacture of A-25-B: Snyder and McNeil	124
257. Rattler Tests for Absorbent Granules : Whetzel	129
258. Determination of Loss in Oxidizing Power of Permanganate Impregnated Soda Lime Granules: Wilson and Chisholm	136
259. Determination of Loss of Oxidizing Power in Permanganate Impregnated Soda Lime Granules: Chisholm	143

DR 15: Soda Lime and Permanganate in General, Part II (Reports 260-273), Arthur B. Lamb

260. The Distribution of G-52 between Charcoal and Soda Lime in Gassed Canisters : Wilson and Baumgardner	148
261. Methods of Analysis and Testing of Raw Materials for A-25-B: Wilson and Whetzel	159
262. Effect of Autoclaving Soda Lime: Whetzel	170
263. G-43 Results on A-46 Soda Limes: Kuhn and Fuller	173
264. Suggested Modifications of British Procedure for the Manufacture of Cement Granules (F-77 Type): Wilson	175
265. Best Raw Materials for A-25-B: Wilson and Ross	185
266. The Accuracy of Absorbent Testing: Wilson and Fuller	198
267. Best Composition of A-25-B: Wilson and Ross	210
268. Evaporation of Sodium Permanganate Solution: Wilson	220
269. Report of Progress on Whetlerite "A" Including Canister Test Results : Wilson	231
270. A Report on the Consistency of the Wet Mix in the Manufacture of A-25-B at Astoria: McNeil and Balmert	234
271. Comparison of British F-77 Granules and Average American A-25-B: Wilson	240
272. Motor Truck Hardness Test of A-25-B: Wilson and Parsons	246
273. Report on the Effect of Moisture Content on the Chemical Efficiency and Physical Properties of A-25-B: Brown & McNeil	264

DR 15: Soda Lime and Permanganate in General, Part III (Reports 274-283), Arthur B. Lamb

274. Experimental Work on the Manufacture of Calcium (and Barium) Permanganate: Wilson, Parsons and Chisholm	274
275. Preparation of Ferric Hydroxide Soda Limes: Whetzel	326
276. Program for Future Work on Special Absorbents	332
277. Outline of Recommended Method for Testing Formula #3 Soda Limes for Hardness or Resistance to Abrasion : Wilson	336

278. The Ammonia Reduction Method for the Determination of Permanganates in the presence of other Oxidizing Agents and Chlorides: Wilson and Chisholm	338
279. Preliminary Note on the Preparation of Collodium Dialyzers of Graded Permeability	346
280. Method of Preparation of Ferric Hydroxide Gel Absorbents: Wilson and Ross	370
281. Method of Testing Hardness of Soda Lime at Columbia University: McNeil	417
282. Informal Summary of Early History of Soda Lime Development: Wilson	420
283. Relation of Abrasion Loss to Compressive Strength of Absorbent Material: Whetzel	437

DR 16: Smokes, Part I (Reports 284-311)[filters]

284. A Comparison of the Principal Smoke Box Mixtures of the Berger Type: Wilson & Reyerson	1
285. British Type S Modified Smoke Box: Reyerson	8
286. Tabulated Results of Smoke Absorption Tests on Various Fabrics: Wilson, Pratt, and Smyth	9
287. Partial Report on Smoke Absorption Tests on Experimental Papers from Bureau of Standards: Wilson & Pratt	14
288. Smoke Absorption Tests on Sulfite Pulp Paper. Samples submitted by the Forest Products Laboratory: Wilson & Pratt	17
289. Note of Efficiency of Creped Cellulose against Solid Smokes: Wilson	20
290. Plugging Tests on Berberry Cloth & Possible Substitutes: Wilson	21
291. Method of Testing Smoke Absorbing Fabrics, Papers, etc., Especially for G-76 Protection: Wilson & Pratt	25
292. Smoke Tests on Papers: Wilson & Pratt	33
293. Smoke Tests on Sulfite Pulp Paper: Wilson & Pratt	36
294. Comparative Tests on Samples of Cotton Pads Submitted by Lieut. Blake and the Standard Cotton Pads: Wilson & Pratt	39
295. Smoke Tests on Various Skins: Wilson & Pratt	42
296. Complete Report of Recent Smoke Tests on Felts: Wilson & Pratt	46
297. Smoke Tests on Experimental Felts Submitted by Major Woodruff: Wilson & Pratt	56
298. Machine Method of Testing Smoke Filters against Solid G-76: Wilson & Smyth	60
299. Smoke Tests on Crepe Papers Submitted by Capt. Rose: Wilson & Pratt	67
300. Survey of Possible Methods of Smoke Removal: Wilson	74
301. 4 th Report on Smoke Tests on Wood Fiber Pulp and Paper Pulp Papers Prepared by the Forest Products Laboratory: Wilson & Pratt	84
302. Smoke Tests on Crepe Papers Submitted by Capt. Rose of the Gas Defense Service: Wilson & Pratt	89
303. Samples of Spruce Cellulose Cotton Submitted by Mr. B.B. Fogler: Wilson & Pratt	98
304. Smoke Tests on Felts Submitted by Mechanical Research &	

American University Technical Reports

Development Section, Army Defense Problem: Wilson & Pratt	102
305. Smoke Tests on Felts Submitted by Mechanical Research & Development Section: Wilson & Hixon	104
306. Smoke Tests on Papers Submitted by Capt. Charles Almy, Jr., Long Island Laboratories. From the American Vulcanized Fiber Company: Wilson & McKellog	106
307. Experiments on the Use of Radioactive Materials in Smoke Precipitation: Wendt	108
308. Sample Tests on Papers Submitted by A.D. Little, Inc., F.S. Pratt, and F.S. Bolton	112
309. A Quantitative Chemical Method for Ammonium Chloride Smoke Testing Machine: Wilson, Pratt, & Hixon	116
310. Some Suggestions Regarding the Production of Toxic Smokes from Substances which are ordinarily incapable of producing Them: Hirschfelder	131
311. Mechanics of Smoke Filtration: Ball, McGrath, Chaney, & Holton	136

DR 16: Smokes, Part II (Reports 312-325)

312. Revised Method for Flange Testing of Filters against NH ₄ Cl Smoke: Wilson & Pratt	171
313. Principles and Practice of Smoke Production: Wilson & Woodward	201
314. Principles and Practice of Smoke Production: Wilson & Woodward	225A
315. Second Note on Absorption of Solid G-76: Wilson	226
316. Gas Absorption Tests with G-76: Wilson, Fuller, & Miller	228
317. Smoke Tests on Crepe Papers prepared by Scott Paper Company: Wilson, Pratt, & Rommel	231
318. Smoke Tests on Crepe Papers Submitted by Capt. Rose of the Gas Defense Service: Wilson & Pratt	247
319. Crepe Paper from Kimberly Clark Co.: Wilson & Pratt	255
320. Proposed Method of Testing Crepe Paper for Gas Defense Type of Internal Wrapped Filter: Wilson	257
321. Effect of Electrical Smoke Precipitators on Efficiency of Absorbents: Wilson & Parsons	268
322. Effect of Bubbling Dry and Humidified Air through Liquid D.A.: Wilson, Pratt, & Bolton	271
323. Utilization of Coconut Fines as an Absorbent: Wilson	280
324. Recommended Formulae of Soda Lime for Industrial Gas Masks: Wilson	283
325. Electrical Precipitation of Toxic Smokes by Individual Units: Wendt	290

DR 17: Electrolytic Production of Permanganates, Part I (Reports 326-341), Arthur B. Lamb

326. Electrolytic Production of Permanganates: Lovelace and Assistants	1
327. Electrolytic Production of Permanganates: Lovelace and Assistants	11
328. Sodium Permanganate Work at John Hopkins University :	

Lovelace	17
329. Electrolytic Production of Permanganates: Lovelace, Lanning and Judefind	19
330. Electrolytic Production of Permanganates: Lovelace, Lanning and Judefind	23
331. Electrolytic Production of Sodium Permanganate from com- mercial Ferromanganese: Wilson and Horsch	25
332. Electrolytic Production of Permanganate: Lovelace, Lanning and Judefind	40
333. Report of Experiments for the Manufacture of Ferromanganese Anodes	42
334. Electrolytic Production of Sodium Permanganate. Preliminary Report on Design of Plant for practical Operation including Cost: Wilson and Horsch	45
335. Electrolytic Production of Sodium Permanganate: Horsch	58
336. Electrolytic Production of NaMnO ₄ Composition of Anolyte: Wilson, Horsch and Youtz	60
337. Electrolytic Production of Ammonium Permanganate and a Tentative General Method for other Permanganates: Lovelace and Lanning	74
338. Electrolytic Preparation of Manganese Dioxide for Catalytic Purposes : Lovelace, Chapman and Saeza	76
339. Electrolytic Production of Sodium Permanganate-Temperature: Horsch and Youtz	81
340. Electrolytic Production of Sodium Permanganate – Effect of Current Density on Current Efficiency, Voltage, and Energy Consumption: Wilson, Horsch and Dudley	97
341. Electrolytic Production of Sodium Permanganate: Informal Report on “Type F” Cell: Horsch	113

DR 17: Electrolytic Production of Permanganates, Part II (Reports 342-344), Arthur B. Lamb

342. Design of Half-Ton Plant for the Electrolytic Production of Sodium Permanganate from Ferromanganese: Wilson and Horsch	118
343. An Electrolytic Process for the Production of Sodium Per- manganate from Ferromanganese: Wilson and Horsch	191
344. Electrolytic Production of Sodium Permanganate from Ferro- manganese: Wilson and Horsch	273

DR 18: Carbon Monoxide, Part I, Pt 1 (Reports 345-369)

345. The Preparation and use of Palladium to remove Carbon Monoxide from Air: Stewart	1
346. Absorption of Carbon Monoxide by Blood Corpuscles: Muller	7
347. Absorption Tests on G-31: Wild	11
348. The Solubility of G-31: Welch	15
349. Preliminary Report on Absorption of CO by CuO, CuO + AgNO ₃ , and CuO + a small Percentage of PD: Scalione and Merrill	19
350. An Improved Absorbent for G-31: Lamb	21
351. Absorbent for G-31: Frazer and Rogers	23

352. Second Report on Absorption of CO with letter of Transmittal: Scalione	24
353. Calorimetric Determination of Carbon Monoxide: Larson	31
354. Report on Carbon Monoxide Canister No. 1: Lamb	40
355. Carbon Monoxide Absorbent: Frazer	48
356. Distribution of Iodine and of Sulfur Trioxide in the War Mixture above Hoolamite after a Canister Run No. 1: Craig	54
357. Investigation of Suitable Absorbents for Iodine Vapor: Kenney and Krivian	61
358. Preliminary Report on Corrosion of Metals by Hoolamite: Bray and Scalione	70
359. Third Preliminary Report on Oxidation of G-31: Frazer, Rogers, Piggot, Jennings, and Bahlke	73
360. Thermal Capacity of Cooling Box from C.W.A. #1Canister: Kenney and Coldard	79
361. Progress Report on Oxidation of CO by Metallic Oxides: Scalione and Merrill	82
362. Progress Report No. 2 on Oxidation of CO by Metallic Oxides: Bray, Scalione, and Merrill	83
363. Progress Report on the Catalytic Oxidation of G-31: Frazer, Rogers, Piggot, Jennings, and Bahlke	91
364. Distribution of Iodic Anhydride in Spent Hoolamite in Canisters: Bray and Krivian	99
365. The Corrosion of Metals by Hoolamite: Hoover	123
366. Preliminary Report on the Use of Palladium Chloride as a Detector for G-31: Van Name and Schumb	136
367. Investigation CMA-1 G-31 Absorbent Air Cooling Experiments: Kenney, Roberts, and Sebastian	139
368. Oxidation of CO by Metallic Oxides, Progress Report No. 3: Scalione and Merrill	145
369. Progress Report on the Oxidation of G-31: Frazer	163

DR 18: Carbon Monoxide, Part II, Pt 1 (Reports 389-398)

389. Report on Preliminary Mode 1 of H-C G-31 Alarm: Coolidge	1
390. Pressure Drop in Canisters	6
391. Calcium Chloride: Merrill	8
392. Report on Calcium Chloride: Van Name	10
393. Supplementary Notes on HL (Canisters):	13
394. Progress Report on Apparatus, Analytical Methods and Procedure for Tube Tests on Carbon Monoxide: I and II: Kenney, Dougherty, Jayson, Larson, and White	23
395. Report on the Influence of the Method of Drying on the Composition and Properties of HC Mixtures: Van Name and Geldard	59
396. The Testing of Calcium Chloride Dryers for use in Canisters: Van Name, Jayson and Akin	79
397. Notes on Humidity Detection and Measurement. Hair Hygro- meter. Dew Point Method. Color Indicators: Van Name, Schumb, Jayson and Scalione	99
398. The Oxidation of Carbon Monoxide by Ozone in the Presence of a Catalytic Agent: Anderegg	116

DR 19: Miscellaneous Reports (Reports 413-438), Arthur B. Lamb

413. Report on the Passivity of Metals: Horsch	1
414. Air Space in Canisters: Lamb and Kenney	8
415. Notes and Observation on the Exposure on Persons to G-25, G-52 and G-43 in connection with Laboratory Test Work: King	12
416. Report on the Action of Certain Substances on Yarns: Hall	17
417. Table showing Relative Value of Different Metals and Alloys in Resisting various corrosive Liquids	23
418. Results to Tests showing Action of Corrosive Liquids on Metals (Trichloromethyl Chloroformate)	24
419. Results of Tests showing Action of Corrosive Liquids on Metals (Stannic Chloride)	25
420. Results of Tests showing Action of Corrosive Liquids on Metals (Ethyl Iodoacetate)	26
421. Results of Tests showing Action of Corrosive Liquids on Metals (Per Chlor Methyl Mercaptan)	27
422. Results of Tests showing Action of Corrosive Liquids on Metals (Benzyl Chloride)	28
423. Results showing Action of Corrosive Liquids and Vapors on Metals (Chloropicrin)	29
424. Results of Tests showing Action of Corrosive Liquids on Metals (Chloropicrin)	30
425. Results of Tests showing Action of Corrosive Liquids on Metals (Xylyl Bromide)	31
426. Report on Metal Vacuum Bottles as Liquid Air Containers: Kraus and Stockbarger	32
427. Conversion Factors and Physical Constants for the most common Toxic Gases: Lamb and Wilson	51
428. Report on Effect of Rate of Flow on Pressure Drop: Pratt and Hixton	54
429. New Methods of Temperature Control for Absorbent Testing Boards: Wilson and Neifert	56
430. Report on Gasket Material for Nozzles of Mobile Gas Sets: Parsons	67
431. An Investigation of the Chlorine Present in Phosgene: Wilson, Silver and Calvin	71
432. Preliminary Report on the Preparation and Purification of Methane: McKelvey and Bowers	78
433. Report 1 on the Preparation of Ca_3As_2 from CaC_2 , CaO and As_2O_3 : Scalione and Merrill	91
434. The Calibration and Care of Small Flowmeters: Etter	95
435. Notes on Improved Gutzeit Apparatus for the Analysis of G-76: Boughton	98
436. Mask Ventilation: Carleton	101
437. Report on the Vaporization of Chloropicrin in the Presence of Stannic Chloride, Silicon Tetrachloride and Titanium Tetra- chloride: Winninghoff and Lucasse	104
438. Report No. 1 on the Solubility of G-7 in Turpentine: Scalione and Merrill	117

GAS MASK RESEARCH SECTION (GMR) :

GMR 1:Reports 1-25, A.C. Fieldner, to Oct 1, 1917

1. Relation of Humidity to Efficiency of Canister. July 27, 1917. Fieldner and Gauger.	1
2. Method of Testing Efficiency of Canisters and Gas Masks for Chlorine, Phosgene, Hydrocyanic Acid, and Chloropicrin. Aug 28, 1917. Fieldner and Teague.	3
3. Report of Canister Tests against Chloroacetone. Sept 13, 1917. Fieldner.	19
4. Gas Chamber Permeability Test using Sachrymatory Gases. Aug 25, 1917. Teague.	21
5. Supplementary Report of Gas Chamber and U.S. Army Canister (First Lot). Tests with Benzyl and Xylyl Bromides. Sept 18, 1917. Fieldner.	26
6. Report of Canister Tests against Di-Methyl-Sulfate. Sept 18, 1917. Fieldner.	29
7. A Quantitative Method for Chloropicrin Estimation by Means of Decomposition in "The Electric Furnace". Watkins and Perrott.	32
8. Report of Canister Tests against Stannic Chloride. Aug 25, 1917. Fieldner.	35
9. Summary Report of Efficiency Tests of One Hundred Fifty Canisters representing the First Lot of Twenty Thousand Respirators. Sept, 1917. Fieldner.	38
10. Report of Age Tests on Regular U.S. Army Canisters (First Lot). Sept 17, 1917. Fieldner.	40
11. Report of Canister Tests against Xylyl Bromide. Sept 13, 1917. Fieldner.	43
12. Report of Work Done on Gas Mask Investigation. July 16, 1917. Fieldner.	45
13. Result of Tests on Men with G-172. Aug 11, 1917. Teague	51
14. Method of Testing Efficiency of Absorbents for Chlorine, Phosgene, Hydrocyanic Acid, Chloropicrin, Xylyl Bromide, and Benzyl Bromide. Aug 28, 1917. Fieldner.	54
15. Accelerated Method of Testing Absorbents for Phosgene. Sept 20, 1917. Fieldner and Harper.	80
16. Accelerated Method of Testing Absorbents for Chloropicrin. Aug 28, 1917. Oberfell and Shinkle.	83
17. Influence of Humidity on the Absorption of Various Gases from Air by Charcoal. Sept 6, 1917. Fieldner.	86
18. Methods for Testing the Efficiencies of Absorbents against Xylyl and Benzyl Bromides. Sept 8, 1917. Perrott	91
19. Method of Sampling Charcoal. Sept 8, 1917. Fieldner.	95
20. Tests on Charcoal with Phosgene. Comparison of 5 and 10 cm Layers. Sept 20, 1917. Fieldner.	99
21. Testing Charcoal with P.S. Comparison of 5 and 10 cm Layers. Sept 20, 1917. Fieldner and Oberfell.	101
22. Report of Absorption Tests on Vegetable Ivory Charcoal and Coconut Charcoal. Aug 1917. Fieldner.	103
23. Preliminary Permeability Experiments on Mask Fabrics with Xylyl Bromide. Sept 17, 1917. Fieldner and Perrott.	108
24. Report of Permeability Tests on Samples of DuPont Fabrikoid	

American University Technical Reports

with Xylyl Bromide and Chloroacetone. Sept 17, 1917. Teague.	114
25. Summary Report of Gas Chamber and Permeability Tests of American and British Gas Masks with Xylyl and Benzyl Bromide. Aug 25, 1917. Fieldner.	117

GMR 2: Reports 26-40, Part I, A.C. Fieldner, Oct 1917

26. Apparatus Type "B" for Testing Efficiency of Canisters for Chloropicrin. Oct 19, 1917. Teague.	1
27. Method for Testing Efficiency of Canisters for Monochloroacetone. Oct 24, 1917. Teague and Hood.	3
28. Calibration of Flowmeters. Oct 25, 1917. Teague.	6
29. Method of Testing Efficiency of Canisters with Benzyl and Xylyl Bromides. Oct 23, 1917. Teague and Benton.	9
30. Report on Carbon Monoxide Tests made on Dr. G.C.W. Frazer's absorbent. Oct 24, 1917. Teague.	13
Routine Man Tests and Standard Canisters. Oct 24, 1917. Lawrence.	
	Report Lost
31. Man Test Data. Investigation Br-1 Canister and Air Resistance. Tests of Filtering Material for Stannic Chloride. Oct 27, 1917. Lawrence and Runals.	15
32. Man Tests Data. Investigations Br-1. Canister Filling and Air Resistance. Oct 25, 1917. Lawrence and Runals.	29
33. Man Tests Data. Investigations Br-1. Canister Filling and Air Resistance. Oct 27, 1917. Lawrence.	38
34. Preliminary Report of Absorption Tests of Charcoal and Soda-Lime Permanganate against Arsine. Oct 4, 1917. Fieldner.	48
35. Report of Absorption Tests on Soda-Lime from Chemical Research Division, against Xylyl Bromide. Oct 8, 1917. Fieldner.	51
36. The Influence of Humidity on the Absorption of Chloropicrin from Air by Charcoal. Oct 22, 1917. Fieldner and Outcault.	53
37. Method of Testing the Efficiency of Absorbents against Arsine. Oct 28, 1917. Pease.	59
38. Effect of Heating Hudson Charcoal on Absorption of Chloropicrin and Phosgene. Oct 27, 1917. Fieldner and Outcault.	63
39. Report of Absorption Tests for the period from August 3 to Oct 5, 1917. Fieldner.	65
40. Report of Absorption Test Section, Oct 1 st to 15 th , 1917. Oct 15, 1917.	78

GMR 2: Reports 41-57a, Part II, A.C. Fieldner, Oct 1917

41. Absorption Tests with the Standard Phosgene Method at 10,000 p.p.m., Oct 10, 1917. Collette.	81
42. A Comparison of the Absorption Capacity of Charcoal for G-25, G-52, and G-43. Oct 22, 1917. Allison and Abrams.	85
43. Summary of Absorption Tests of Charcoal and Soda-Lime Permanganate; and Permeability of Gas Mask Fabrics, Oct 16 th to 31 st , 1917, inclusive. Oct 29, 1917. Oberfell.	92

American University Technical Reports

44. Test for Leaks around Eyepiece of Mask. Oct 27, 1917. Oberfell.	96
45. Report of Absorption Tests on Soda-Lime Samples Accelerated Method. Oct 23, 1917. Oberfell and Spofford.	98
46. Results of Permeability Tests on Fabrics for Gas Masks. Oct 15, 1917. Perrott.	103
47. Results of Permeability Tests on Fabrics for <u>Gas Masks</u> . Oct 26, 1917. Perrott.	106
48. Standard <u>Physiological Tests</u> on Permeability of Fabrics. Oct 26, 1917. Perrott.	108
49. Permeability Test Report. Oct 22, 1917. Oberfell.	114
50. Effect of Repeated Short Exposures on Permeability of Mask Fabrics. Oct 22, 1917. Perrott.	121
51. Resumé of Vacuum Treatment, Experiments for Revivifying Mask Fabrics. Oct 29, 1917. Perrott.	123
52. Standard Physiological Test for Permeability of Mask Fabrics. Oct 18, 1917. Perrott.	125
53. Result of Permeability Tests of Ginsburg Fabrics with Xylyl Bromide and Chloropicrin. Not dated. Perrott.	133
54. Standard Chemical Test for Permeability of Mask Fabrics. Oct 29, 1917. Fieldner and Perrott.	136
55. Summary of Bi-Monthly Report, September 16-30, 1917. Oct 1, 1917. Fieldner.	140
56. Chemical Report of First Lot of U.S. Army Masks sent to France. Oct 1, 1917. Fieldner.	147
57. Report of Progress on Gas Mask Examination Division, October 1 st to 15 th , 1917, inclusive. Oct 15, 1917. Fieldner.	169
57a. Report of Progress on Gas Mask Examination Division, October 16 th to 31 st , 1917, inclusive. Oct 31, 1917. Fieldner.	174

GMR 3: Reports 58-116, A.C. Fieldner, Nov 1917

58. Specification and Calibration of Flow Meter. Nov 7, 1917. Teague and Hood.	1
59. Report on Channel Tests. Nov 9, 1917. Teague.	7
60. Partial Report on Filtering Materials to be used in Canisters as Protection against S-25 and Similar Substances. Nov 7, 1917. Teague.	10
61. The Determination of G-4 Vapor in Air Mixture. Nov 26, 1917. Yoe.	16
62. Report on the Comparison of Hudson and Astoria A-4 from Canister Machine Tests against G-25. Nov 16, 1917. Teague.	21
63. Apparatus Type "B" for Testing Efficiency of Canisters against HCN. Nov 11, 1917. Teague and Pease.	24
64. Method of Testing Efficiency of Canisters with G-49. Nov 24, 1917. Teague and Hood.	27
65. Resumé of Canister Tests. Nov 25, 1917. Teague.	31
66. Calibration of Men for Breathing Rate, Number of Inhalations per minute. Nov 28, 1917. Benton.	33
67. Method of Testing Efficiency of Canister against G-31. Nov 30, 1917. Teague and Williams.	44
68. Corrections Bringing the Method of Testing Canisters against Chlorine up to date. Nov 22, 1917. Teague.	47
69. Corrections Bringing the Method of Testing Canisters against	

American University Technical Reports

Chloropicrin to date. Nov 22, 1917. Teague.	49
70. Corrections Bringing Method of Testing Canisters against Phosgene up to date. Nov 22, 1917. Teague.	51
71. Man Test Data Investigation Br-1 Canister Filtering and Air Resistance. Test of Filtering Materials against S-25. Nov 5, 1917. Lawrence and Runals.	53
72. Method of Making Resistance Tests and Man Tests of Box Respirators against S-25. Nov 8, 1917. Fieldner.	64
73. Chemical Control of Man Tests G-25 Supplementary Report No. 2 (a). Nov 8, 1917. Lawrence and Henley.	66
74. Man Test with G-25, Efficiency of Several Charcoals as Components of Canister Filling. Nov 10, 1917. Fieldner and Lawrence	69
75. Description of Gas Chamber used for Man Tests. Supplementary Report No. 1. Nov 10, 1917. Lawrence and Finn.	74
76. Chemical Control Man Tests G-28 Supplementary Report No. 2 (b). Nov 10, 1917. Lawrence and Harper.	76
77. Chemical Control Man Tests S-25 Supplementary Report No. 2 (c). Nov, 1917. Lawrence and Finn.	79
78. Chemical Control Man Tests G-52 Supplementary Report No. 2 (d). Nov 12, 1917. Lawrence and Beattie.	82
79. Chemical Control of Man Tests G-16 Supplementary Report No. 2 (e). Nov 24, 1917. Lawrence and Henley.	85
80. Man Test with G-28. Channeling Test on U.S.B.R. Nov 17, 1917. Fieldner and Lawrence.	88
81. Man Test with S-25 of Two-Layer Filter Pads. Nov 17, 1917. Fieldner and Lawrence.	92
82. Man Test with S-25. Tests of Filter Pads over Extended Period of Time. Nov 17, 1917. Fieldner and Lawrence.	96
83. Chemical Control Man Test S-4 Supplementary Report No. 2 (f). Nov 24, 1917. Lawrence and Henley.	100
84. Test of Filtering Materials against S-25. Nov 8, 1917. Lawrence and Runals	103
85. Memorandum. Special Man Tests on U.S. Canisters. Nov 16, 1917. Lawrence.	112
86. Man Tests with S-25. Tests of 15 Special Canisters from Hero Manufacturing Co. Nov 22, 1917. Fieldner and Lawrence.	114
87. Memorandum. Special Man Tests on Two Canisters sent by Major Bradley Dewey. Nov 19, 1917. Lawrence.	118
88. Man Tests on Navy Gas Masks. Tests with G-16, G-25, and S-4. Nov 27, 1917. Fieldner and Lawrence.	120
89. Man Tests G-25. Test of Horse Mask. Nov 24, 1917. Lawrence and Runals	124
90. Man Test with G-25. Test for leakage around Canister Joints. Nov 9, 1917. Lawrence and Runals.	128
91. Concentration Test with G-25. Nov 3, 1917. Lawrence and Harper.	131
92. Resistance Tests and Man Tests of Box Respirators against S-25. Nov 10, 1917. Fieldner.	133
93. Instructions for Standard <u>Method of Testing</u> Efficiency of Absorbents. Nov 11, 1917. Fieldner.	135
94. Report of Laboratory <u>Absorption</u> Test Section for November 15, 1917. Nov 15, 1917. Oberfell.	138
95. Report of Laboratory Absorption Test Section, November 10 th to	

American University Technical Reports

25 th , 1917. Nov 25, 1917. Oberfell.	144
96. Experiments on A-4, S-10 and 10-14 Mesh Materials, Nov 25, 1917. Fieldner.	147
97. Experiments on Methods for Obtaining the Apparent <u>Densities</u> of Absorbents. Nov 25, 1917. Oberfell and Shinkle.	150
98. Standard Methods of Testing Efficiency of Absorbents. Nov 25, 1917. Fieldner and Oberfell.	154
99. Comparison of Iodine and Silver Nitrate Methods for Determining HCN. Nov 25, 1917. Oberfell and Abrams.	159
Experiments showing the Effect of Testing A-4 with G-25. Oberfell.	
100. Experiments on filling Absorption Tubes with Soda-Lime. Nov 28, 1917. Abrams.	Report lost
101. The Effect of Grinding Charcoal during Sampling on the Efficiency of Absorption of Chloropicrin. Nov 3, 1917. Oberfell and Shinkle.	163
102. A Comparison of the Standard G-25 Apparatus and the Accelerated G-25 Apparatus. No date. Oberfell and Shinkle.	165
103. Analysis of G-25 by Sodium Sulfate Method. Nov 25, 1917. Oberfell and others.	168
104. Absorbent, Hoover, Report on Passing Air through Dr. Hoover's Special Absorbent #16. Shinkle.	173
105. Comparison of Standard and Accelerated Apparatus using Astoria Charcoal. Tests with Chloropicrin and Phosgene. Nov 7, 1917. Oberfell.	176
106. Carbon Dioxide, Masks. Carbon Dioxide on Dead Air Space of Face Piece of Masks. Nov 1, 1918. Oberfell and Nichols	178
107. Report of Laboratory Absorption Tests of Canister Filling Materials and Permeability Tests of Gas Mask Fabrics. Nov 16, 1917. Oberfell.	180
108. Report of Permeability Test Section from November 25 th to November 30 th , 1917. Perrott.	182
109. Physiological Permeability Tests with Xylyl Bromide. Nov 3, 1917. Perrott.	187
110. Results of Repeated Tests on Mask Materials exposed to Chloropicrin until breakdown. Nov 3, 1917. Perrott.	192
111. Standard Chloropicrin Tests for Permeability of Mask Fabrics. Nov 3, 1917. Fieldner and Perrott.	195
112. Results of Standard Chemical Tests Experiments for Permeability Mask Fabrics. Nov 8, 1917. Perrott.	198
113. Rate of Permeation of Mask Materials after Short Exposure and Subsequent Confinement in Closed Space. Nov 15, 1917. Perrott and Yablick	201
114. Comparison of Results of Physiological and G-25 Chemical Tests for Permeability of Mask Fabrics. Nov 16, 1917. Perrott	204
115. The Choice of Fabrics for the Gas Mask. Nov 1917. John Johnson	208
116. Comparison of Results of Physiological and G-25 Chemical Tests on Permeability of Mask Fabrics. Nov 16, 1917. Perrott and others	211
	222

117. Report on Canister Tests made against G-4. Dec 10, 1917. Teague	1
118. <u>Method for Testing</u> the Efficiency of Canisters against G-4. Dec 10, 1917. Yoe and Teague	3
119. Partial Report on Canister Tests against G-172. Dec 6, 1917. Teague	7
120. A Method of Regulating the Humidity of Canister Tests. Dec 10, 1917. Teague and Pease	9
121. Reg. U.S. Canister Resume' Report of Canister Tests, November 25 th to December 10 th , 1917. Teague.	12
122. Sup. Report on Canister Tests against G-172. Dec 28, 1917. Teague and Richards.	14
123. Summary Report of Efficiency of U.S. Box Respirators, Packed during Month of November 17 th . Dec 15, 1917. Fieldner and Teague	18
124. Report on Investigation of Various Proportions of Absorbents in Canisters. Dec 13, 1917. Fieldner and Teague	21
125. Partial Report of the Examination of Foreign Masks. Dec 17, 1917. Fieldner and Teague.	24
126. Reg. U.S. Canisters, Resume' Report of Canister Tests. December 11, 1917 to December 25, 1917. Fieldner and Teague.	26
127. Canister Report of Machine Tests on Different Sized A-25 Granules. Dec 30, 1917. Fieldner and Teague.	28
128. Method of Testing the Efficiency of Canisters against Acrolein. Dec 10, 1917. Teague and Yoe.	32
129. Man Tests with Navy Canisters against S-25, G-25 and G-52. Dec 28, 1917. Lawrence and Others.	37
130. Man Tests with S-25. Tests of one Four-Layer Pad. Dec 29, 1917. Lawrence and Others.	52
131. Man Tests with S-28. Tests of Filter Pads. Dec 29, 1917. Lawrence, Harper, and Collette	56
132. Description of Gas Chamber used for Man Tests. Supplementary Report No. 1 (a). Dec 18, 1917. Lawrence and Collette.	60
133. Man Tests on Different Proportions of Materials for Canister Filling. Dec 10, 1917. Fieldner and Lawrence.	63
134. Man Tests with G-25 Efficiency of Different Sized Charcoals as Components of Canister Filling. Dec 10, 1917. Fieldner and Lawrence.	70
135. Man Tests with S-25. Tests of Two 1-Layer Filter Pads and of One 3-Layer Pad. Dec 3, 1917. Fieldner and Lawrence.	74
136. Comparisons of Efficiencies of Foreign and U.S. Canisters. Dec 20, 1917. Lawrence and Others.	78
137. Special Man Tests on U.S. Standard Canisters. Dec 14, 1917. Lawrence.	84
138. Man Tests with Navy-Canisters. Tests against S-4. Dec 1, 1917. Lawrence	86
139. Memorandum, Special Tests on Horse Masks. Dec 11, 1917. Lawrence.	88
140. Memorandum, Special Tests on Horse Masks. Dec 21, 1917. Lawrence.	90
141. Memorandum, Man Tests with S-25. Tests of Filter Pads composed of Steel Shavings and Glass Wool. Dec 19, 1917. Lawrence.	92

American University Technical Reports

142. <u>Method of Testing the Efficiency of Absorbents against Arsine.</u> Dec 8, 1917. Pease.	94
143. Report of Laboratory Absorption Test Section for December 10 th to December 25 th , 1917. Dec 25, 1917. Oberfell.	97
144. Report of Laboratory Absorption Test Section for November 25 th to December 10 th , 1917. Dec 10, 1917. Oberfell.	100
145. Permeability Tests against G-25 at Different Concentrations. Dec 3, 1917. Perrott and Yablick.	103
146. Multiple Tube Apparatus for Testing Efficiencies of Absorbents for Phosgene. Dec 14, 1917. Oberfell.	106
147. Report of the Permeability Test Section from December 10 th to December 25 th , 1917. Dec 30, 1917. Perrott.	111
148. Report of Permeability Test Section for November 25 th to December 10 th , 1917. Dec 15, 1917. Perrott.	114
149. Permeability Tests against G-25 at Different Concentrations. Dec 3, 1917. Perrott and Yablick.	119
150. Permeability of Mask Fabrics against Different Gases. Dec 15, 1917. Perrott and Fieldner.	123
151. Permeability Tests on Experimental Tissot Type Mask. Dec 6, 1917. Perrott.	129
152. Report of the Gas Mask Examination Division, November 16 th to 30 th , 1917. Dec 11, 1917. Fieldner.	133
153. Report of Gas Mask Examination Division, December 1 st to 15 th , 1917. Dec 15, 1917. Fieldner.	140

GMR 5: Reports 154-207, A.C. Fieldner, Jan 1918

154. Report on the Daily Filling Efficiencies of Reg. U.S. Cans. during November. Jan 4, 1918. Teague.	1
155. Comparison of Canister Tests on Different Gases. Jan 15, 1918. Teague.	3
156. Reg. U.S. Cans. Resume' Report of Canister Tests, December 25 th to January 11 th . Jan 11, 1918. Teague.	5
157. Apparatus Type "C" Intermittent for Testing Canisters against G-25. Jan 25, 1918. Teague and Pierce.	7
158. Resume' Report of Canister Tests, January 10 th to 25 th . Jan 25, 1918. Teague.	9
159. Report on the Daily Filling Efficiencies of Reg. U.S. Cans. from December 1 st to 15 th , 1917. Jan 15, 1918. Teague.	11
160. Report on the Daily Filling Efficiencies and Resistances of Reg. U.S. Cans. from December 1 st to January 10 th , 1918. Jan 31, 1918. Teague.	13
161. Method of Determination of G-37 Vapors in Air Mixtures. Arnold.	16
162. Comparison of the Different Sizes of U.S. Canisters. Jan 25, 1918. Fieldner and Teague	27
163. Report on the Daily Filling Efficiencies and Resistances of Reg. U.S. Cans. from January 10 th to 25 th , 1918. Jan 15, 1918. Teague.	31
164. Partial Report of the Examination of Foreign Masks. Jan 30, 1918. Fieldner and Teague.	33
165. Leakage Test on Intermittent Valves. Jan 31, 1918. Swift.	36
166. Apparatus Type "C" (Intermittent) for Testing Cans. against Chloropicrin. Jan 25, 1918. Teague and Pierce.	39

167. Method of Testing Cans. against Monochloroacetone. Jan 5, 1918. Teague and Hood.	41
Special Man Tests on U.S. Standard Canisters. Jan 14, 1918 Lawrence	Report lost
168. Impregnations and Testing of Horse Masks and P.H. Helmets. Jan 30, 1918. Lawrence and Beattie.	45
169. Memo. Tests of Horse Masks. Jan 24, 1918. Lawrence.	54
170. Memo. Tests of Horse Masks. Jan 23, 1918. Lawrence.	56
171. Memorandum Test of Two Horse Masks and One P.H. Helmet. Jan 22, 1918.	59
172. Memorandum, Special Tests on Horse Masks. Jan 15, 1918. Lawrence.	61
173. Memorandum Special Tests on Horse Masks. Jan 11, 1918. Lawrence.	63
174. Memorandum Special Tests on Horse Masks. Jan 4, 1918. Lawrence.	65
175. Man Tests with all Rubber Gas Masks of the Tissot Type. Permeability and Fit Test. Jan 10, 1918. Lawrence and Others	67
176. Report of Man Test. Tests of Special Types of Canisters against G-52. Jan 30, 1918. Lawrence.	71
177. Memorandum Man Tests with Cellulose Filter Pads against S-25. Jan 22, 1918. Lawrence.	73
178. Memorandum of Man Tests. Special Tests of Cotton Wadding Filter Pads. Jan 30, 1918. Lawrence.	75
179. Memorandum Man Tests with S-25 using Canisters of Special Design. Jan 25, 1918. Lawrence.	77
180. Man Tests with G-52. Efficiency of Different Sizes of A-25 as Components of Canister Fillings. Jan 9, 1918. Lawrence and Others.	79
181. Absorption Resume'. Report of Laboratory Absorption Test Section for December 25, 1917 to January 10, 1918. Jan 10, 1918. Oberfell.	85
182. Absorption Resume' Report of Laboratory Test Section for January 10 th , 1918 to January 25 th , 1918. Jan 25, 1918. Oberfell.	88
183. Charcoal Comparison. A Comparison of the Qualities of A-4 produced at the CODC Plant as shown by Tests of Daily Samples from December 14, 1917 to January 19, 1918. Jan 31, 1918. Fieldner and Oberfell	92
184. Soda-Lime Layers. Comparison of Efficiency Tests on A-25 B.C. Tests with G-52 on 5 cm Layers and 10 cm Layers. Jan 14, 1918. Oberfell and Others.	94
185. Mask Comparison. A Report on German, French, English, and American. Jan 19, 1918. Fieldner.	97
186. Apparent Density. Apparent Density Values by Different Methods. Jan 31, 1918. Ruby and Oberfell.	142
187. Apparatus Two Tube Specifications for Two Tube Absorption Apparatus. Jan 17, 1918.	150
188. Apparatus Two Tube. Working Drawings and Specifications for Standard Two Tube Absorption Apparatus. Jan 31, 1918. Outcault and Oberfell	152
189. Charcoal, Aging. Report on the Aging of A-4. Jan 24, 1918. Shinkle and Oberfell.	155
190. A Comparison of the Quality of A-4 Produced at the CODC Plant	

American University Technical Reports

as shown by Tests of Daily Samples from November 6 th to December 14 th , 1917. Jan 5, 1918. Oberfell and Fieldner.	169
191. Methods for Apparent Density Determinations and for Filling and Packing of Absorption Tubes. Jan 10, 1918. Oberfell.	172
192. Report of Permeability Test Section from December 25 th to January 10 th , 1918. Jan 10, 1918. Perrott.	175
193. Report of Permeability Test Section from January 10 th to 25 th , 1918. Jan 25, 1918. Perrott.	183
194. Summary of Results of Aging Tests on Permeability of Mask Fabrics. Jan 25, 1918. Perrott and Feld	185
195. Preliminary Report of Permeability Tests with G-34. Jan 25, 1918. Perrott and Feld.	189
196. Report of Tests made on Goodyear Fabric P-189. Jan 25, 1918. Perrott and Fieldner.	192
197. Method for Determining the Time of Aeration of Mask Fabrics. Jan 15, 1918. Fieldner and Perrott.	196
198. Preliminary Report on Investigation of Filters for S-25. Jan 7, 1918. Perrott and Others.	198
199. Progress Report on Smoke Filter Investigations. Jan 25, 1918. Perrott and Others.	201
200. The Choice of Fabrics for the Gas Mask. Appendix Supplementary to Previous Report. Jan 1, 1918. Johnson and Perrott.	204
201. Summary of Results of Aging Tests on Mask Fabrics. Jan 10, 1918. Perrott.	214
202. The Effect of Varying Humidity and Concentration on the Efficiency of A-4 as an Absorbent of G-43. Jan 18, 1918. Allison.	221
203. The Variation with Concentration of the Absorption Capacity of A-4 for G-43. Jan 5, 1918. Allison.	238
204. Accomplishments of the Gas Mask Research Division during Month of December, 1917. Jan 5, 1918. Fieldner.	248
205. Report of Gas Mask Examination Division, December 16 th to 31 st , 1917. Jan 7, 1918. Fieldner.	252
206. Report of Gas Mask Examination, January 1 st to 15 th , 1918. Jan 15, 1918. Fieldner.	259
207. Report of Gas Mask Research Division, January 15 th to 31 st , 1918. Jan 31, 1918. Fieldner.	272

GMR 6: Reports 208-268, A.C. Fieldner, Feb 1918

208. Method of testing the Efficiency of Cans. against G-37. Feb 5, 1918. Teague and Mulligan.	1
209. Protection afforded by Regular U.S. Cans. against G-37. Feb 4, 1918. Teague.	4
210. Comparison of British and U.S. Cans. Feb 6, 1918. Fieldner.	7
211. Protection afforded by Regular U.S. Canisters against G-67. Feb 8, 1918. Teague.	9
212. Comparison of Continuous and Intermittent Machine Tests with Man Tests against G-25. Feb 9, 1918. Teague and Swift.	11
213. Resumé' Report of Canister Tests, January 25 th to February 15 th and "F" Packing Comparison Curves. Feb 15, 1918. Teague.	19
214. The Determination of G-76 in Air Mixtures. Feb 25, 1918. Arnold.	22

American University Technical Reports

215. Method of Testing the Efficiency of Canisters against G-178. Feb 25, 1918. Teague and Smith.	30
216. Method of Testing the Efficiency of Canisters against Cyanogen Chloride. Feb 25, 1918. Teague and Smith.	33
217. Method of Testing the Efficiency of Canisters against G-67. Feb 25, 1918. Teague and Smith.	37
218. Method of Testing the Efficiency of Canisters against G-76. Feb 25, 1918. Teague and Arnold.	40
219. Report of the Daily Filling Efficiencies and Resistances of Regular U.S. Canisters, January 25 th to February 10 th , 1918. Feb 25, 1918. Teague.	43
220. Resume' Report of Canister Tests, February 10 th to 25 th , 1918. Feb 25, 1918. Teague.	45
221. Comparison of British and United States Canisters. Feb 6, 1918. Fieldner.	47
222. Methods of Testing Canisters against Cyanogen Bromide. Feb 25, 1918. Teague and Smith.	49
223. Description of Gas Chamber used in Man Test. Supplementary Report No. 1 (b). Feb 18, 1918. Lawrence and Henley.	53
224. A Survey of the Concentration of Gases in Gas Chamber described in Supplementary Report No. 1 (b). Feb 18, 1918. Lawrence and Henley.	57
225. Impregnation and Testing of Horse Masks. Effect of Time and Method of Impregnation. Feb 9, 1918. Lawrence.	61
226. Comparison of U.S. and British Horse Masks. Feb 13, 1918. Lawrence.	67
227. Life Tests on the U.S.B.R. Man Tests with S-25, S-28, G-25, G-52 and G-28. Feb 11, 1918. Lawrence and Others.	69
228. Chemical Control of Man Tests S-22. Supplementary Report No. 2 (h). Feb 20, 1918. Lawrence and Henley.	95
229. Chemical Control of Man Tests S-28. Supplementary Report No. 2 (g). Feb 20, 1918. Lawrence and Henley.	98
230. Efficiency of the U.S.B.R. against S-22, as determined by Man Tests. Feb 12, 1918. Lawrence and Others.	101
231. One-Hour Impregnation (lost) York Mfg. Company. Feb 21, 1918.	Report lost
232. Horse Mask Data obtained from Man Tests. Feb 14, 1918. Lawrence.	109
233. Horse Mask Data obtained from Man Tests. Feb 21, 1918. Lawrence.	112
234. Impregnation with Modified Greasene and Testing of Horse Masks. Feb 1, 1918. Lawrence and Beattie.	115
235. Assembly Tests on Masks submitted by Lieut. Zimmerman. Feb 27, 1918. Lawrence.	120
236. Man Tests Report on Canisters packed with A-25 from Capt. Sill, Astoria. Feb, 18, 1918. Lawrence.	123
237. Report of Man Tests. Tests on Special Types of Canisters against G-52. Feb 12, 1918. Lawrence.	127
238. Memorandum of Man Tests. Special Tests of Cotton Wadding Filter Pads. Feb 13, 1918. Lawrence.	130
239. Memorandum of Man Tests. Special Tests of Cotton Wadding. Feb 19, 1918. Lawrence.	132
240. Report of Man Tests. Special Tests for Lieut. Teague. Feb 12, 1918.	134

241. A Test of Army Masks for Protection from Atmosphere containing Sulfur Dioxide. Feb 22, 1918. Jones and Katz.	136
242. Man Tests on Hero Canisters. Feb 2, 1918. Lawrence.	142
243. Chemical Control of Man Test S-28. Supplementary Report No. 2 (g) missing. Lawrence and Others.	144
244. Chemical Control of Man Test, S-22. Supplementary Report No. 2 (b) missing. Lawrence and Others.	147
245. A Comparison of the Quality of A-4 produced at the CODC Plant as shown by Tests of Daily Samples from February 2 nd to 12 th , 1918. Feb 25, 1918. Oberfell.	150
246. Charcoal Moisture Preliminary Report. The Effect of Moisture Content upon the Absorption of Charcoal. Feb 15, 1918. Oberfell and Shinkle.	153
247. Charcoal Aging. Preliminary Report. The Aging of Charcoal Exposures under Atmospheric Conditions. Feb 15, 1918. Oberfell and Shinkle.	161
248. Apparent Density. An Investigation of Factors influencing the Determination of Apparent Density. Feb 15, 1918. Oberfell & Ruby	172
249. Report of Laboratory Absorption Test Section for January 25 th to February 10 th , 1918. Feb 16, 1918. Oberfell.	190
250. Charcoal Comparison. A Comparison of the Quality of A-4, Produced at the CODC Plant as shown by Tests of Daily Samples, January 20 th to February 10 th , 1918. Feb 15, 1918. Oberfell.	193
251. Absorbents, Comparison. A Comparison of Several British and American Absorbents. Feb 16, 1918. Oberfell and Burns.	196
252. Orsat Apparatus. Working Drawing and Specifications for Portable Orsat Gas Analysis Apparatus. Feb 20, 1918. Outcault and Oberfell.	210
253. Absorption Temperature. The Effect of Temperature on the Absorption Value of Charcoal and Soda-Lime for G-25 and G-52. Feb 21, 1918. Oberfell and Bailey.	213
254. Analysis of Absorbent taken from a German Canister. Feb 25, 1918. Selving and Osgood.	221
255. Report on Laboratory Absorption Test Section from February 10 th to 25 th , 1918. Feb 25, 1918. Oberfell.	225
256. The Determination of the Moisture Content of Charcoal at Room Temperature. February 26 th , 1918. Oberfell and Others.	227
257. A Comparison of the Quality of Charcoal Produced at CODC Plant as shown by Tests of Samples from February 2 nd to 12 th , 1918. Oberfell.	233
258. Standard Methods of Testing Efficiencies of Absorbent Gases G-25, G-52, G-43, G-7, G-28, G-16, and G-172. Feb 5, 1918. Fieldner.	236
259. Progress Report of Smoke Filter Investigations. Feb 28, 1918. Perrott and Yablick.	256
260. Progress Report of Smoke Filter Investigations. Feb 28, 1918. Perrott and Yablick.	260
261. Report of Gas Mask Section from February 10 th to February 25 th , 1918. Feb 25, 1918. Perrott.	264
262. Report of Gas Mask Section from January 25 th to February 10 th , 1918. Feb 10, 1918. Perrott.	266
263. Investigation of Methods for Preservation of G-4. Feb 10, 1918. Perrott and Others.	268

264. A Low Resistance Smoke Filter. Feb 10, 1918. Perrott and Others.	272
265. Man Tests of French M-2 Mask against Sulfur Dioxide with Notes on the Effect of Low Concentrations of Sulfur Dioxide on the Eyes and Throat. Feb 23, 1918. Paul and Katz.	276
266. Accomplishments of Gas Mask Research Division during Month of January, 1918. Feb 14, 1918. Fieldner.	284
267. Report of Gas Mask Research Division, February 1 st to 15 th , 1918. Feb 15, 1918. Fieldner.	287
268. Report of Gas Mask Research Division, February 16 th to 28 th , 1918. February 28, 1918. Fieldner.	299

GMR 7: Reports 269-307, A.C. Fieldner, March 1918

269. <u>Methods of Testing</u> Efficiency of Canisters against Ammonia. March 12, 1918. Yoe and Kubler.	1
270. <u>Methods of Testing</u> Efficiency of Canisters against Carbon Monoxide. March 12, 1918. Teague and Yoe.	5
271. Report on the Daily Efficiencies and Resistance of Reg. U.S. Cans., January 1 st to February 10 th , 1918. March 11, 1918. Teague	10
272. Concentrations – Time Relation to Standard Canister Tests against G-28. March 10, 1918. Teague and Pease.	19
273. Daily Filling Efficiencies and Resistances of U.S. Canisters. March 11, 1918. Teague.	26
274. Report of Machine Tests on Standard Canisters against G-76. March 11, 1918. Teague and Arnold.	28
275. Protection afforded by regular U.S. Canisters against G-178. March 18, 1918. Teague and Smith.	33
276. Protection afforded by regular U.S. and German Canisters against G-178. March 26, 1918. Teague and Smith.	35
277. <u>Method of Testing</u> Efficiency of Canisters and Gas Masks against Stannic and Arsenic Chloride. Teague and Milligan.	45
278. Resume' Report of Canister Tests, February 25 th to March 10 th , 1918. March 11, 1918. Teague.	51
279. The Development of <u>Smoke Filters in Box Respirators</u> . March 18, 1918. Fieldner.	54
280. Report on the Daily Filling Efficiencies and Resistances of Regular U.S. Canisters, January 1 st to March 5 th , 1918. March 26, 1918. Teague.	57
281. Efficiency of <u>Smoke Filter</u> of the Bag Type against G-76 as shown by <u>Man Tests</u> . March 30, 1918. Lawrence and Others.	69
282. <u>Man Tests</u> with B.M. Standard Smoke. March 1, 1918. Lawrence and Harper.	82
283. Effect of the Withrow Modification on the Efficiency of the U.S.B.R. Man Test with G-52. March 1, 1918. Lawrence and Others.	88
284. Man Test Data on Standard U.S.B.R. Tested against Different Concentrations of G-52. March 1, 1918. Lawrence and Others.	93
285. Man Test with G-337. March 6, 1918. Lawrence and Jordy	98
286. Man Test with G-25, using Canisters submitted by Lieut. Teague. March 20, 1918. Lawrence.	102
287. Efficiency of Smoke Filters of the Reg. Type against G-76 as shown by Man Tests. March 30, 1918. Lawrence and Others.	104

American University Technical Reports

288. Comparison of Masks. March 1, 1918. Bancroft.	116
289. A Summary of Samples Analyzed and Reported for Period February 10 th to March 25 th , 1918. March 28, 1918. Oberfell.	122
290. Results of Apparent Density Determination by the Modified Standard Method. March 11, 1918. Oberfell and Gortner.	127
291. The Variation with Concentration of the Absorption of G-43 by A-8. March 8, 1918. Allison.	133
292. Results of Tube Tests on the W.A. Patrick Absorbent and Notes upon its value as a Substitute for Coal. March 15, 1918. Oberfell and Others.	141
293. Standard Sample A-4 CODC No. 1. March 1, 1918. Fieldner.	152
294. A Comparison of Tests Made at American University January 1 st to March 9 th , 1918. Also Astoria.	158
295. Report of Absorption Section for February 10 th to March 25 th , 1918. Oberfell.	164
296. A Comparison of the Quality of Charcoal produced at CODC Plant as shown by Tests of Samples from February 2 nd to March 9 th , 1918. Oberfell.	169
297. The Accelerated Chloropicrin Apparatus containing Modifications adopted at the Conference of Analytical Methods on January 4 th , 1918. Oberfell and Others.	172
298. An Investigation of the Standard Accelerated Method for Testing Charcoal with Chloropicrin. March 16, 1918. Oberfell and Others.	181
299. Standard Samples of A-4 CODC No. 1. March 31 st , 1918. Oberfell	190
300. Outline of Method of Study of Effect of Humidity on taking up of Arsine by Charcoal. March 21, 1918. Oberfell.	198
301. Puncture Tests of Tissot Type Mask. March 14, 1918. Perrott and Yablick.	201
302. Effect of Punctured on Tissot Type Mask. March 21, 1918. Perrott and Yablick.	204
303. Permeability Tests of American, English, French, and German Masks. Perrott and Others.	209
304. Test of Permeability of Mask Fabrics and Material for Protective Clothing, from March 10 th to 25 th , 1918. Perrott.	215
305. Report of Gas Mask Fabric Section from February 25 th to March 10 th , 1918. March 15, 1918. Perrott.	219
306. The Variation with Concentration of the Absorption of G-43 by A-8. March 8, 1918. Allison.	222
307. Report of the Gas Mask Research Division, March 1 st to 15 th , 1918. March 15, 1918. Fieldner	230

GMR 8: Reports 308-315, Part I, A.C. Fieldner, April 1918

308. The Development of <u>Carbon Monoxide</u> Canister No. 1. April 20, 1918. Yoe and Teague.	1
309. Resume' Report of <u>Canister</u> Tests, March 10 th to 25 th , 1918. April 1, 1918. Teague	54
310. A Method of <u>Calibrating</u> Very Small <u>Flow-Meters</u> . April 12, 1918. Teague and Benton.	56
311. The Determination of <u>Perchloromethylmercaptan</u> in Air Mixtures. April 15, 1918. Arnold and Moore.	60
312. Non-Edited. Report on the Efficiencies of Special Dome Canister, Designed by the Mechanical Research Division. April 15, 1918.	

Teague and Rich.	68
313. Report on the Daily Filling Efficiencies and Resistances of Reg. U.S. Canisters, March 25 th to April 10 th , 1918. April 15, 1918. Teague.	77
314. Resume' Report of <u>Canister</u> Tests, March 25 th to April 10 th , 1918. April 10, 1918. Teague.	79
315. Specifications and Precautions on the Construction and Use of Gas <u>Flow-Meters</u> . April 13, 1918. A.F. Benton	81

GMR 8: Reports 316-341, Part II, A.C. Fieldner, April 1918

316. Resume' Report of Canister Tests and Filling Efficiencies of Standard U.S. Canisters, 4-10—25—18. April 30, 1918. Teague	91
317. Investigation of Resistance-Tube Flow-Meters. April 12, 1918. Benton.	94
318. Report on Canister (Machine) Tests on the Effect of Different Arrangements of Cotton Pads. April 30, 1918. Teague.	111
319. Efficiency of Various Felts against G-76 as shown by Man Test. April 10, 1918. Lawrence and Others.	134
320. Investigation of the Causes of the Variation in <u>Man Test</u> Results with <u>G-76</u> as obtained at <u>American Univ. Exp. Sta.</u> and at <u>Phila. Control Laboratory</u> . April 6, 1918. Lawrence.	138
321. Resume' Report of Routine Man Tests, April 8 – 25, 1918. April 25, 1918. Lawrence.	146
322. Effect of Various Proportions of <u>Charcoal</u> and <u>Soda-Lime</u> on the Efficiency of the <u>U.S.B.R.</u> as shown by <u>Man Tests</u> with <u>G-52</u> . April 22, 1918. Lawrence and Others.	149
323. Investigation of the Causes of the Variation in <u>Man Test</u> Results with <u>G-76</u> as obtained at the <u>American Univ. Exp. Sta.</u> and at the <u>Long Island Lab.</u> of the Gas Defense Service. April 24, 1918. Lawrence and Others.	156
324. Method of Securing <u>Concentrations</u> of <u>G-76</u> for <u>Man Tests</u> at the <u>American Univ. Exp. Sta.</u> Supplementary Report No. 2 (i). April 25, 1918. Lawrence.	164
325. Effect of <u>Formaldehyde</u> on <u>G-25</u> . April 8 – 18. Lawrence and Harper.	167
326. Report of Absorption Test Section for March 25 th to April 10 th , 1918. April 15, 1918. Oberfell.	170
327. A Comparison of the Quality of <u>Charcoal</u> Produced at the <u>CODC</u> Plant as shown by Tests on Daily <u>Samples</u> from March 9 th to April 3 rd , 1918. April 15, 1918. Oberfell.	176
328. The Standard Accelerated Method for Testing <u>Absorbents</u> with Chloropicrin. April 10, 1918. Oberfell and Others.	179
329. The Effect of Temperature on the Service Time of Soda-Lime with G-7. April 15, 1918. Oberfell and Others.	188
330. Tube Test Results on 8-10 and 8-14 Mesh Soda-Lime with G-52. April 18, 1918. Oberfell and Others.	194
331. Report of Absorption Test Section from April 10 th to April 25 th , 1918. April 25, 1918. Oberfell.	199
332. A Comparison of Tests made at American Univ. and Astoria for the period February 19 th to April 16 th , 1918. Oberfell.	203
333. A Comparison of the Quality of Soda-Lime Produced at the Astoria Plant as shown by Tests on Daily Samples from February	

American University Technical Reports

19 th to April 30 th , 1918. April 30, 1918. Oberfell.	210
334. A Comparison of the Quality of Charcoal Produced at the <u>CODC</u> Plant as shown by Tests on Daily Samples from April 4 th to April 16 th , 1918. April 30, 1918. Oberfell.	213
335. Summary of Tests of Fabric for Gas Masks and Protective Clothing. April 15, 1918. Perrott and Yablick.	216
336. Effect of Weathering on DuPont Fabrics. April 15 th , 1918. Perrott and Yablick.	221
337. Resume' of Tests of Fabrics for Gas Masks and Protective Clothing. April 25, 1918. Perrott.	225
338. Factor between the Results of <u>G-25</u> and <u>G-34</u> Permeability Tests. April 25, 1918. Perrott.	228
339. Efficiency of Boiled Oil Seam Varnish. April 25, 1918. Perrott, Feld, and Marsh	233
340. Efficiency of <u>G-34</u> , Protective Field Suits. April 25, 1918. Perrott.	238
341. Relation between Rate of Flow and Service Time of Wood Charcoal in absorbing <u>Chlorine</u> . April 10, 1918. Fieldner, Satler, and Locke.	242

GMR 9: Reports 373-396, Part II, A.C. Fieldner, May 1918

373. The use of Silver Nitrate as a Qualitative Test for G-7 and a Method of Converting Time to Qualitative Test to Time of Tests for 99% and 95% Efficiency. May 1918. Oberfell and Depew.	154
374. Report of Absorption Test Section for April 25, 1918 to May 10, 1918. May 13, 1918. Oberfell.	157
375. A Comparison of the Quality of Charcoal produced at the CODC Plant as shown by Tests on Daily Samples from April 17 th , 1918, to May 3, 1918. May 13, 1918. Oberfell.	163
376. Time Correction Factors for Tests with the Standard Accelerated Chloropicrin Apparatus. May 5, 1918. Oberfell and Voress.	166
377. A Comparison of the Quality of Soda Lime Produced at the Astoria Plant as shown by Tests of Daily Samples from April 7 to May 1, 1918. May 15, 1918. Oberfell.	174
378. A Color Chart for use with British Phosgene Test Paper. May 13, 1918. Oberfell and Burns.	177
379. Special Report of the Absorbing Power of the Present U.S. Canister Filling for Arsine. May 13, 1918. Oberfell and Depew.	183
380. The Effect of Moisture Content upon the Absorption Value of Charcoal. May 10, 1918. Oberfell and Shinkle.	189
381. A Record of Daily Relative Humidities at the American University, December 1917 to April 1918. March 25, 1918. Miller.	200
382. Report of Absorption Test Section for May 10, 1918 to May 25, 1918. May 25, 1918. Oberfell.	203
383. Investigation of an Accelerated Method of Testing Charcoal with Phosgene. May 21, 1918. Oberfell and Burns.	208
384. A Comparison of Tests made at American University and Astoria for the period April 7, 1918, to May 18, 1918. May 28, 1918. Oberfell.	224
385. An Investigation of Factors Influencing the Accuracy of Tests of Charcoal with Phosgene. May 20, 1918. Oberfell.	232
386. A Method for Testing the Purity of Phosgene. May 23, 1918. Oberfell and Burns.	248

387. Investigation of the Mohr Method of Titration for Hydrochloric Acid. May 27, 1918. Mase.	253
388. Resume' of Tests of Fabrics for Gas Masks and Protective Clothing. May 10, 1918. Perrott.	263
389. Investigation of Materials for Protective Screens in Dugouts. May 4, 1918. Perrott and Yablick.	267
390. Permeability Experiments with Chloropicrin on Oil Soaked Blanket Material. May 4, 1918. Dean and Hill.	283
391. Resume' of Tests of Fabrics for Gas Masks and Protective Clothing. May 28, 1918. Perrott.	297
392. Stabilization of G-4. May 28, 1918. Perrott and Yablick.	302
393. Investigation of Materials for Protective Screens in Dugouts. May 4, 1918. Perrott and Yablick.	308
394. Investigation of the Flow of Gases through Canisters. May 6, 1918. Fieldner and Beattie.	324
395. Investigation of the Flow of Gases through Canisters. May 10, 1918. Fieldner and Beattie.	330
396. Gas Mask Research Division Progress Report. May 1, 1918. Fieldner.	335

GMR 10: Reports 397-422, Part I, A.C. Fieldner, June 1918

397. Preliminary Report on Efficiency of Canisters filled with Whetlerite "A". June 6, 1918. Teague.	1
398. Efficiency of the Navy Canister Type "D" Filling against various Gases. June 3, 1918. Teague.	4
399. Testing of Navy Canisters. June 10, 1918. Teague.	9
400. Resume' Report of Canister Tests and Filling Efficiencies of Standard U.S. Canisters. May 25 to June 10, 1918. Teague	15
401. Determination of Diphenylchloroarsine in Air Mixtures. June 4, 1918. Heuer & Arnold.	18
402. Method of Testing Bag Filters against Diphenylchloroarsine. June 3, 1918. Teague and Arnold.	24
403. Protection afforded by Standard Bag Filter Canisters against G-76. June 8, 1918. Arnold and Heuer.	31
404. Relative Penetrating Power of Different forms of Diphenylchloroarsine. June 5, 1918. Teague and Arnold.	37
405. Comparison of continuous and intermittent Machine Tests with Man Tests against G-25. June 10, 1918. Teague and Baird.	45
406. Method of Testing Efficiency of Canisters against Perchlormethylmercaptan. June 10, 1918. Teague and Arnold.	55
407. Protection afforded by standard U.S. Army and German Canisters against Bromobenzylcyanide. June 10, 1918. Teague and Others	59
408. Protection afforded by standard U.S. Army and German Canisters against Perchlormethylmercaptan. June 10, 1918. Teague and Others.	65
409. Resume' Report of Experiments on Effect of Resistance in Gas Masks on Men. Nutrition Lab., Boston. June 7-12, 1918. Denton.	74
410. Notes on Qualitative Tests for Chlorcyanogen. June 19, 1918. Pease and Bradley.	78
411. General Apparatus and Notes on Routine Canister Testing. June 10, 1918. Teague.	82
412. Method of Testing Efficiency of Canisters against Chlorine. June	

10, 1918. Fieldner, Ganger & Teague.	94
413. Method of Testing Canisters against Chloropicrin. June 10, 1918. Teague and Pease.	100
414. Method of Testing Canisters against Phosgene. June 10, 1918. Fieldner and Others	107
415. Method of Testing Canisters against HCN. June 10, 1918. Teague and Pease.	111
416. Method of Testing Canisters against Superpalite. June 10, 1918. Teague and Hood.	116
417. Method of Testing Canisters against Arsine. June 10, 1918. Teague and Others.	120
418. Method of Testing Canisters against Benzyl and Xylyl Bromide. June 10, 1918. Teague and Benton.	125
419. Method of Testing Canisters against Dimethyl Sulfate. June 10, 1918. Teague and Milligan.	129
420. Method of Testing Canisters against Cyanogen Chloride. June 10, 1918. Teague and Smith.	133
421. Resume' Report of Canister Tests, June 10 to June 25, 1918. June 25, 1918. Teague.	137
422. Methods of Testing Canisters against Various War Gases. June 10, 1918. Fieldner and Teague.	140

GMR 10: Reports 423-436, Part II, A.C. Fieldner, June 1918

423. Comparison of Continuous, Intermittent, and Man Tests against G-52. June 18, 1918. Teague, Bailey & Parker.	218
424. The Use of Tobacco Smoke in Testing Canisters Equipped with Special Filtering Devices. June 14, 1918. Arnold.	227
425. The Effect of Oscillation Rate in Intermittent Testing against G-52. June 18, 1918. Teague.	233
426. The Development of Carbon Monoxide Canisters, Numbers 2 & 3. June 15, 1918. Yoe.	237
427. Report on the Efficiency of the Gibbs Rescue Apparatus Canister. June 26, 1918. Yoe.	250
428. Special Studies in Connection with C.M.A.-1, C.M.A.-2, and C.M.A.-3 Canisters. June 20, 1918. Yoe.	253
429. Method of Testing the Efficiency of Canisters against Phenyl Carbylamine-chloride. June 25, 1918. Smith and Nelson.	276
430. The Determination of Phenyl Carbylamine Chloride in Air Mixtures. June 25, 1918. Nelson & Smith.	282
431. Concentration on Time Relation for Standard U.S. Canisters against G-25. June 25, 1918. Teague and Pease.	288
432. Report on the Efficiency of Gibbs Rescue Apparatus Canister. June 26, 1918. Yoe.	293
433. Method of Determining Small Amounts of Methyl-Dichloroarsine in Air Mixtures. June 25, 1918. Nelson and Smith.	296
434. The Determination of 2-4 Dichlorobenzyl Bromide in Air Mixtures. June 28, 1918. Powell.	302
435. Effect of Moisture on the Efficiency of Standard U.S. Canisters. June 24, 1918. Teague and Carter.	309
436. Preliminary Report of Experiments on the Effect of Resistance of Box Respirators on the Wearer's Efficiency. June 26, 1918. Benton.	326

GMR 10: Reports 437-460, Part III, A.C. Fieldner, June 1918

437. Effect of Baffles on the Life of the Former Navy Type Canisters. June 3, 1918. Lawrence.	334
438. Efficiency of the U.S.B.R. against Chloroacetophenone as shown by Man Tests. June 10, 1918. Lawrence and Others.	343
439. Fit Test on Ravenna Rubber Co. Modified Tissot Masks. June 15, 1918. Lawrence and Others.	349
440. Resume' of Man Tests, May 26 to June 10, 1918. June 11, 1918. Lawrence.	354
441. Resume' Report of Routine Tests of the Man Test Section. June 10, to 25, 1918. Lawrence.	357
442. Fit Test on Kopp's Type Modified Tissot Mask. June 22, 1918. Lawrence and Others	361
443. Method of Sampling Diphenylchloroarsine for Determination of Solid Particles and Gas in Chamber Concentrations. Supplement- ary Report No. 2 (m). June 17, 1918. Lawrence and Mullen.	367
444. Effect of Different Degrees of Stirring on Concentrations of Diphenylchloroarsine in Gas Chamber. June 17, 1918. Lawrence and Others.	374
445. The Effect of Continued Breathing of Humid Air on the Efficiency of the U.S.B.R. as shown by Man Tests. June 24, 1918. Lawrence and Others	381
446. Efficiency of the Standard U.S.B.R. and the Modified Tissot Face Piece against Chloroacetophenone as shown by Man Tests. June 26, 1918. Lawrence, Harper and Jordy.	389
447. The Efficiency of the Standard U.S.B.R. against G-313 as shown by Man Tests. June 27, 1918. Lawrence Harper and Jordy.	396
448. Report of Absorption Test Section for Period from May 25, 1918 to June 10, 1918. June 14, 1918. Oberfell.	401
449. A Comparison of the Wet and Dry Bulb Thermometer Device, and the Sulfuric Acid Method for Humidity Control. June 7, 1918. Oberfell and Frick.	405
450. The Aging of Charcoal. June 6, 1918. Oberfell and Shinkle.	421
451. A Comparison of the Quality of Charcoal Produced at the CODC Plant as shown by Tests on Daily Samples from May 4 to June 2, 1918. June 14, 1918. Oberfell.	439
452. A Comparison of the Quality of Soda Lime produced at the Astoria Plant as shown by Tests of Daily Samples from May 3, 1918 to June 2, 1918. June 12, 1918. Oberfell.	443
453. Investigation of pressure developed when Charcoal is shaken with H_2O in closed container. Oberfell and Ruby.	446
454. Methods of Analysis for Cl_2 , $COCl_2$, HCN , Cl_3CNO_2 . Oberfell.	450
455. Resume' Report of Absorption Test Section for Period from June 10 to June 25, 1918. Oberfell.	457
456. The determination of Cyanogen by an Iodometric Titration, June 15, 1918. Oberfell and Ruby.	462
457. A Comparison of Tests made at the American University and Astoria for the Period from May 18, 1918 to June 12, 1918. Oberfell.	471
458. The Moisture Content of Charcoal at Various Relative Humidities and the Time Required to Reach Equilibrium at the Standard	

American University Technical Reports

Breathing Rate. June 22, 1918. Oberfell and Outcault.	478
459. Relation between Canister Tests and Tube Tests of Soda Lime against Phosgene. June 14, 1918. Oberfell and Mase.	491
460. A Method for the Determination of HCN and (CN) ₂ in Air. June 15, 1918. Oberfell and Ruby.	513

GMR 10: Reports 461-474, Part IV, A.C. Fieldner, June 1918

461. Resume' of Tests of Fabrics for Gas Masks and Protective Clothing. June 10, 1918. Perrott	529
462. Investigation of Materials for Protective Screens in Dugouts. June 7, 1918. Perrott and Yablick.	534
463. Permeability of Fabrics to G-313. June 10, 1918. Perrott and Marsh.	541
464. Resume' of Tests of Fabrics for Gas Masks and Protective Clothing. June 28, 1918. Perrott.	549
465. Tests of Air Lined Suits. June 18, 1918. Perrott.	553
466. A G-34 Field Detector. June 18, 1918. Yablick and Perrott.	558
467. Permeability of Food Containers. June 29, 1918. Perrott and Feld.	564
468. Investigation of Flow of Gases through Low Resistance Canisters. June 7, 1918. Fieldner and Beattie.	570
469. Effect of Various Methods of Packing Canisters on Wave Front and Life, and Description of an Improved Method of Packing. June 24, 1918. Beattie, Hyslop and Brady	587
470. Standard Orifice for Checking Flowmeter on Pressure Drop Machine. June 24, 1918. Fieldner, Beattie & Fogleson	601
471. Analysis of Phosgene by Fractionation. June 14, 1918. Katz and Jones.	606
472. A New Multiple Machine for Testing Canisters with Intermittent Flow. June 10, 1918. Fieldner and Others.	621
473. Progress Report of Canister Testing Section. June 1918. Fieldner.	635
474. Important Developments in the Gas Mask Research Division for the Month of June, 1918. Fieldner.	639

GMR 11: Reports 475-496, Part I-A, A.C. Fieldner, July 1918

475. Current Method of Separating the Constituents of the War Gas Mixture of the Standard U.S. Canisters. July 10, 1918. Yoe.	1
476. Resume' Report of Canister Tests and Filling Efficiencies of Standard U.S. Canisters. July 10, 1918. Teague.	4
477. Report of Canister Tests on a Sample of Rankinite "A" against G-52 and G-178. July 17, 1918. Yoe and Fieldner.	7
478. Preliminary Report on Whetlerite 14-20 Mesh in Navy Canister. July 9, 1918. Yoe.	12
479. Report on the Efficiency of C.M.A.-3 Canister packed with a two-inch layer of F-5 Absorbent. July 9, 1918. Yoe.	16
480. The Chaney Method of raising Concentrations of G-76 Smoke. July 10, 1918. Reese & Horton.	19
481. Report on the Efficiency of Two Salvus ½ Hour CO ₂ Canisters. July 29, 1918. Yoe.	24
482. Effect of Jolting on the Efficiency of the CMA-3 Canister. July 20, 1918. Fieldner & Yoe.	27

483. Resume' Report of Canister Tests and Filling Efficiencies of Standard U.S. Canisters. July 26, 1918. Teague.	30
484. Report on Method of Testing the Filtering Efficiency of Canisters against a Standard Smoke. July 9, 1918. Arnold & Horton.	33
485. New Method for Obtaining Concentrations of Gases. July 10, 1918. Teague & Yoe.	41
486. Comparison of Intermittent and Continuous Machine Tests against G-49. July 10, 1918. Teague, Pease and Baird	51
487. Protection Afforded by Standard U.S. Army and German Canisters against G-73. July 9, 1918. Teague and Smith.	57
488. Method of Testing the Efficiency of Canisters against Methyl Dichloroarsine. July 10, 1918. Smith and McCarthy.	63
489. Effect of Aging of Canister. July 20, 1918. Teague and Carter.	69
490. Volume and Rate of Respiration of Man at Different Degrees of Work. July 15, 1918. Benton.	78
491. Method of Analysis for Small Amounts of Adamsite. July 20, 1918. Cox.	86
492. Method of Analysis for Large Amounts of Adamsite. July 17, 1918. Cox.	90
493. Determination of Adamsite in Air Mixture. July 20, 1918. Cox.	94
494. Standard Intermittent Testing Machine. July 20, 1918. Teague.	100
495. Method of Testing Filtering Efficiency of Canisters against a Standard Ammonium Chloride Smoke. July 22, 1918. Arnold & Werthan.	106
496. Protection Afforded by Standard U.S. Army and German Canisters against G-313. July 25, 1918. Yoe and Smith.	115

GMR 11: Reports 497-515, Part I-B, A.C. Fieldner, July 1918

497. Comparison of the Various Tests used for determining Filtering Efficiencies of Canisters and Protection against G-76. July 25, 1918. Arnold.	121
498. Method of Testing the Efficiency of Canisters against Sulfur Dioxide. July 26, 1918. Yoe and McCarthy.	128
499. Protection afforded by Standard U.S. Army and German Canisters against Sulfur Dioxide. July 27, 1918. McCarthy.	132
500. Tests on Canisters against Smoke Concentrations in the Bomb Pit and Field. July 27, 1918. Arnold and Others.	137
501. Report on Canister Test with G-31 Absorbent #117. July 31, 1918. Yoe.	145
502. U.S. Army Canisters tested on the Machine in a Horizontal Position. July 30, 1918. Pease.	147
503. Results of Canister Tests on Whetlerite against G-52 and G-178. July 26, 1918. Yoe and Pease.	154
504. The Effects of Different Proportions of Absorbents on the Efficiency of Canisters against G-52. July 8, 1918. Fieldner.	163
505. Effect of Various Proportions of Charcoal and Soda Lime on the Efficiency of the U.S.B.R. as shown by Man Tests with G-52. July 8, 1918. Lawrence and Others.	173
506. Resume' Report of Routine Tests of the Man Test Section. July 11, 1918. Lawrence and Fieldner.	182
507. Man Test Laboratory – Its Construction and Operation. August 6, 1918. Lawrence & Others.	187

508. Efficiency of the Standard U.S.B.R. against G-25 when the concentration is put up by detonation. July 6, 1918. Lawrence & Harper.	209
509. Fit Test on Howe Type Modified Tissot Mask. July 6, 1918. Lawrence, Jordy and Glennie	213
510. Resume' Report on Routine Tests of the Man Test Section. July 30, 1918. Lawrence & MacFarlane.	219
511. Efficiency of the Standard U.S.B.R. against Nitrogen Peroxide as shown by Man Tests. July 8, 1918. Lawrence, Harper and Jordy	224
512. Efficiency of the Standard U.S.B.R. against a Mixture of G-178 and G-52 and against G-178 alone. July 16, 1918. Lawrence, Harper & Jordy.	228
513. Efficiency of the Standard U.S.B.R. against Sulfur Dioxide as shown by Man Tests. July 24, 1918. Lawrence, Harper & MacFarlane.	235
514. Efficiency of the Standard U.S.B.R. against Nitrogen Peroxide as shown by Man Tests. July 24, 1918. Lawrence, Harper & Jordy.	241
515. Efficiency of the Standard U.S.B.R. against detonated Tobacco Snuff as shown by Man Tests. July 24, 1918. Lawrence, Harper and Mullen.	245

GMR 11: Reports 516-543, Part II, A.C. Fieldner, July 1918

516. Resume' Report of Absorbent Testing Section for Period June 25 to July 10, 1918. July 12, 1918. Tyner and Oberfell.	250
517. The Quality of Astoria Charcoal and Soda Lime. Results of Tube Tests on Mixture Samples from March 30 to June 2, 1918. July 15, 1918. Oberfell.	255
518. Resume Report of the Absorbent Testing Section, July 10 to 25, 1918. July 29, 1918. Oberfell.	259
519. Specifications for the Mixing of Charcoal in Preparation of Sample for Tube Tests. July 20, 1918. Oberfell and Voress.	267
520. The Deterioration of Sodium Sulfite Solution. July 23, 1918. Oberfell and Gortner.	277
521. A Two Tube Apparatus for Testing Absorbents with Binary Gas Mixtures. July 17, 1918. Oberfell and Ruby.	283
522. A Field Detector for G-34. July 19, 1918. Oberfell and Burns.	290
523. Apparatus for Analysis of Air in Submarines. July 24, 1918. Oberfell, Ruby and Outcault.	297
524. Comparison of Astoria and American University Tube Tests of Absorbents. June 12 to July 11, 1918. July 20, 1918. Oberfell.	306
525. The Quality of Absorbents Produced at the Astoria Plant from June 3, 1918, to July 17, 1918. July 30, 1918. Oberfell.	314
526. Report on Analysis of Phosgene for Man Tests Section. July 11, 1918. Frick.	322
527. The Action of HCN and (CN) ₂ on various Gas Mask Absorbents. July 31, 1918. Oberfell, Ruby and Meserve.	325
528. Selenious Acid - G-34 Detector. Preliminary Report. Yablick and Perrott.	341
529. Resume' of Tests of Fabrics for Gas Masks and Protective Clothing. July 15, 1918. Perrott.	345
530. Resume' of Tests of Fabrics for Gas Masks and Protective Clothing. July 25, 1918. Perrott.	349

American University Technical Reports

531. Selenious Acid as a G-34 Detector, Preliminary Report. Yablick, Furman and Perrott.	353
532. Protective Underwear Fabrics, Preliminary Report. July 25, 1918. Greensfelder, Frantz and Perrott.	358
533. Impregnation of Blanket Curtains for Dugouts. July 29, 1918. Perrott.	365
534. Quantitative Method for Estimation of Traces of G-34. Preliminary Report. July 29, 1918. Furman, Yablick and Perrott.	370
535. Little Canfield Canisters with and without Lugs on Bottom Screen. July 1, 1918. Beattie.	377
536. Effect of Temperature on Absorption of G-52 by Canisters. July 22, 1918. Katz, Cox and Gladstein.	384
537. Effect of Temperature on Absorption of G-52 by Canisters. July 29, 1918. Katz.	394
538. Preliminary Report on the System of Field Testing C.D.S.L.I. July 20, 1918. Jordy.	403
539. Description of Humidifying Machine. July 8, 1918. Lawrence and Collette	407
540. A Multiple Machine for Testing Canisters with Intermittent Flow for Hydrocyanic Acid. July 17, 1918. Lawrence, Collette and Bailey.	413
541. The Quantitative Decomposition of Chloropicrin by means of an Electric Furnace. July 18, 1918. Lawrence, Collette and Henley.	423
542. Report Absent.	
543. Report on Progress of the Gas Mask Research Division, C.W.S., for month of July. Fieldner.	460

GMR 12: Reports 544-569, Part I, A.C. Fieldner, Aug 1918

544. Report on the Efficiency of a Modified Gibb's CO ₂ Canister. Aug 3, 1918. Yoe.	1
545. Resume' Report on Canister Tests, July 25 to August 10, 1918 and Report on Daily Filling Efficiencies and Resistances of Standard U.S. Canisters. Aug 14, 1918. Yoe.	3
546. Protection afforded by Standard U.S. Army Canisters against S-4. Aug 28, 1918. Yoe and Pease.	6
547. Report on the Efficiency of the CMA-3 Type of Canister. Aug 7, 1918. Fieldner and Collette.	11
548. Method of Testing the Efficiency of Canisters against Phenyl- dichloroarsine. Aug 21, 1918. Smith and Nelson.	14
549. Method of Testing the Efficiency of Canisters against Carbon Bisulfide. Aug 16, 1918. Yoe, Ford and Nelson.	24
550. Protection afforded by Standard U.S. Army and German Canisters against G-100. Aug 20, 1918. Yoe and Smith.	32
551. Method of Testing the Efficiency of Canisters against Thio- phosgene. Aug 12, 1918. Smith and Scull.	39
552. Protection afforded by Standard U.S. Army Canisters against Carbon Bisulfide. Aug 19, 1918. Yoe, Nelson and Ford.	46
553. A Report on CMA-3 Canisters Test with H1-11. Aug 21, 1918. Yoe and Kuebler.	51
554. A Report on the Efficiency of the Modified CO Salvus Canister. Aug 23, 1918. Yoe.	58

American University Technical Reports

555. A Report on the Test with CMA-3 Canister packed with Hopcalite. Aug 15, 1918. Fieldner and Yoe.	60
556. Comparison of Protection afforded by Standard U.S. Army Canisters of H Type and J Type Packing, against Standard Gases. Aug 17, 1918. Yoe.	62
557. Varying Proportions of Absorbents noted in Inner and Outer Portions of Standard U.S. Army Canisters, Type "H". Aug 22, 1918. Yoe.	72
558. Apparatus for Producing Gas Mixtures from Small Amounts of Liquids. Aug 27, 1918. Smith, Yoe and Burton.	77
559. Results on Canister Tests on Samples of Whetlerite against G-52 and G-178. Yoe and Pease.	91
560. Method of Analysis of X ₁ and X ₂ . August 17, 1918. Powell.	102
561. Resume' Report of Routine Tests of the Man Test Unit. July 25 to Aug 10, 1918. August 12, 1918. Lawrence and Howe.	117
562. Efficiency of the Standard U.S.B.R. against G-349. Aug 8, 1918. Lawrence, Harper and MacFarlane.	122
563. Effect of Variations in the Weight per Detonator of G-76 on the Concentration produced. Aug 2, 1918. Lawrence, Harper and Mullen.	127
564. Resume' Report of Routine Tests of the Man Test Unit. Aug 10 to Aug 25, 1918. Gephart and Howe.	132
565. Chemical Control of Man Tests. Aug 15, 1918. Lawrence, Mullen and Rising	137
566. Analysis of Mixtures of Phosgene and Chlorcyanogen. Aug 9, 1918. Lawrence, Supple and MacFarlane.	191
567. Efficiency of the Standard U.S.B.R. against a mixture of G-178 and G-25. Aug 16, 1918. Lawrence, Harper and Supple.	204
568. Efficiency of the German Smoke Filter against G-76 and S-22. Aug 19, 1918. Lawrence and MacFarlane.	209
569. Determination of Cyanogen Chloride and Chloropicrin in a mixture of the Two Gases. Aug 19, 1918. Supple, MacFarlane and Lawrence.	214

GMR 12: Reports 570-594, Part II, A.C. Fieldner, Aug 1918

570. Resume' Report of Absorbent Testing Unit. July 25 to Aug 19, 1918. Aug 12, 1918. Oberfell.	222
571. Effect of Humidity on the Absorption of Arsine by Charcoal. Aug 10, 1918. Oberfell and Depew.	230
572. Resume' Report of the Absorbent Testing Unit. Aug 10 to 25, 1918. Oberfell, Shinkle and Miller	239
573. A Comparison of Astoria and American University Tube Tests Results on Astoria Absorbents for July 9, to Aug 3, 1918. Oberfell.	247
574. The Quality of Absorbents produced at the Astoria Plant from July 18, to Aug 5, 1918. Oberfell.	256
575. The Effect of Absorption of Moisture and Carbon Dioxide from Air at Various Relative Humidities upon the Absorption Value of Soda Lime against G-52. Aug 19, 1918. Oberfell and Outcault.	262
576. A Comparison of Methods for Determining Cyanogen Chloride in Air Mixtures. Aug 22, 1918. Frick and Sebrell.	274
577. Permeability Tests of American, English, French and German	

American University Technical Reports

Masks. Aug 1918. Perrott, Yablick and Feld.	287
578. Permeability of Rubber Fabrics to Xylyl Bromide. Aug 24, 1918. Fieldner & Teague.	292
579. Resume' of Tests of Fabrics for Gas Masks and Protective Clothing. Aug 12, 1918. Perrott.	295
580. Selenious Acid on Pumice Stone. An Indicator of Presence of G-34 in Soil. Aug 27 1918. March, Yablick and Perrott.	298
581. Protective Underwear Fabric Progress Report. Aug 26, 1918. Perrott, Greensfelder and Frantz.	303
582. Tests on the New Horse Mask. Aug 21, 1918. Perrott.	310
583. Investigation of the Flow of Gases through Canisters. Aug 8, 1918. Beattie & Ernest.	321
584. Chemical Control of Man Tests. Aug 15, 1918. Beattie & Helgeson.	327
585. Design of a Special Canister for Protection against Hydrocyanic Acid for Agricultural Department. Aug 19, 1918. Beattie & Ernest.	338
586. A Duplex Machine for Studying the Course of Gas through Canisters. Aug 28, 1918. Beattie, Ernest, Fogelson & Helgeson.	343
587. Effect of Temperature on Absorption of G-25 by Canisters. Aug 20, 1918. Katz, Cox and Gladstein.	354
588. Resume' Report, Intermittent Canister Tests. Aug 10, 1918, and Report of Daily Filling Efficiencies and Resistances of Standard Type G and Type H Hero Canisters. Aug 10, 1918. Fieldner and Collette.	362
588a. Resume' Report Intermittent Canister Tests, Aug 11 – Aug 26 (see loose reports).	
589. Relation between Continuous and Intermittent Machine Tests, against G-43. Aug 14, 1918. Bailey and Shirley.	366
590. A Comparison of Type H and Type J Standard Canisters. Aug 28, 1918. Fieldner & Henley.	375
591. Life of Type H, U.S. Canisters against G-43 at Various Concentrations. Aug 9, 1918. Holden and Collette.	385
592. Report on Efficiency of CMA-3 Canister. Aug 7, 1918. Fieldner and Collette.	391
593. Proposed British Method of Detecting Traces of G-25. Aug 7, 1918. Fieldner.	395
594. Comparisons of different types of Allied and Enemy Respirators. Aug 16, 1918.	401

GMR 13: Reports 595-617, Part I, A.C. Fieldner, Sept 1918

595. Method of Testing the Efficiency of Canisters against Chloroacetophenone. Sept 3, 1918. Scull and Nelson.	1
596. Protection afforded by Standard U.S. Army and German Canisters against G-349. Sept 3, 1918. Yoe, Nelson and Allen.	9
597. Report on Canister Tests with G-31 Absorbent HC #200. Sept 24, 1918. Yoe.	15
598. Protection afforded by the Standard U.S. Army Canister against Chloroacetophenone. Sept 25, 1918. Yoe, Nelson and Scull.	17
599. Protection afforded by the Standard U.S. Box Canisters against Mixture of G-25 and G-178. Sept 3, 1918. Yoe, Charlton and	

American University Technical Reports

Hansom.	23
600. Sources of error in Canister Testing. Sept 24, 1918. Benton.	32
601. Method of Testing the Efficiency of Canisters against Chloro-acetylchloride. Sept 30, 1918. Nelson and Powell.	45
602. Resume' Report of Routine Tests of the Man Test Unit. Aug 26, 1918 to Sept 9, 1918. Howe and Gephart.	52
603. Methods of Establishing Concentrations of G-76. Sept 4, 1918. Lawrence, Mullen & MacFarlane.	55
604. Efficiency of the Standard U.S.B.R. against various Gas Mixtures. Sept 7, 1918. Lawrence, MacFarlane and Vilbrandt	73
605. Man Tests with Hero Canisters. Sept 11, 1918. MacFarlane, Shafer and Harper.	80
606. Efficiency of the U.S. Type J against G-52 and G-25. Sept 13, 1918. Lawrence, MacFarlane and Balch.	86
607. Resume' Report of the Man Test Unit. Sept 10-25, 1918. Gephart and Howe.	91
608. The Detection of Arsine in small amounts. Sept 3, 1918. Oberfell and Depew	94
609. Resume' Report of the Absorbent Testing Unit. Aug 25 to Sept 10, 1918. Sept 11, 1918. Oberfell, Shinkle and Mullen.	100
610. Aging of Soda Lime. Sept 3, 1918. Oberfell and Sebrell.	109
611. Sensitivity of Capt. D.M.S. Tate's Gas Detector. Sept 14, 1918. Oberfell & Frick.	122
612. Relation between Canister Tests and Tube Tests of Charcoal against G-52. Sept 12, 1918. Oberfell and Mase.	128
613. Relation between Canister and Tube Tests of Charcoal against G-43. Sept 23, 1918. Oberfell.	155
614. Resume' Report of Absorbent Testing Unit. Sept 25, 1918. Oberfell, Shinkle and Miller.	172
615. Comparison of the American University and Astoria Tube Tests Aug 4-29, 1918. Sept 10, 1918. Oberfell, Shinkle and Miller.	180
616. The Action of G-52 on Various Gas Mask Absorbents. Sept 12, 1918. Oberfell and Miller.	190
617. The Effect of Temperature on the Absorption Value of Charcoal against G-43. Sept 26, 1918. Oberfell, Meserve and Dean.	201

GMR 13: Reports 618-637, Part II, A.C. Fieldner, Sept 1918

618. Resume' of Tests of Fabrics for Gas Masks and Protective Clothing. Sept 11, 1918. Perrott.	208
619. Permeability of Fabrics to G-178. Sept 24, 1918. Perrott, Bassett, and Yablick.	211
620. Specifications for Oil Impregnation Media for Dugout Curtains. Sept 26, 1918. Perrott and Yablick.	217
621. Mustard Gas for Training Purposes. Sept 26, 1918. Yablick and Perrott.	222
622. Dugout Blankets. Sept 25, 1918. Perrott and Feld.	227
623. Resume' Report of Tests of Fabrics for Gas Masks and Protective Clothing. Sept 25, 1918. Perrott.	235
624. Canister Packing for Protection against Hydrogen Sulfide. Sept 9, 1918. Beattie and Helgeson.	238
625. Effect of Temperature on Absorption of G-43 by Canisters. Sept 11, 1918. Katz, Cox and Gladstein.	243

626. Notes on Method for the Analysis of G-52. Edgewood Arsenal Method. Katz.	252
627. Effect of Temperature on the Absorption of G-178 by Canisters. Sept 27, 1918. Katz, Cox and Gladstein.	254
628. A New Max. Work Man Test for Low Resistance Canisters. Sept 18, 1918. Jordy & Gephart.	264
629. Preliminary Report Standard Field Tests on Miller Tissot Masks. Sept 24, 1918. Jordy and Gephart.	277
630. Leakage of Face Pieces at High Breathing Rates. Sept 30, 1918. Jordy, Fieldner and Collette.	298
631. Resume' Report of Routine Tests of the Intermittent Canister Test Unit. Sept 11, 1918. Collette.	305
632. Resume' Report of the Intermittent Canister Test. Sept 16, 1918. Fieldner & Collette.	308
633. Life of Type H, U.S. Army Canisters against HCN at Various Concentrations. Sept 14, 1918. Collette, Holden and Shively.	312
634. Resume' Report of the Routine Tests for the Canister Testing Unit. Sept 26, 1918. Collette. 3 rd Report.	320
635. Resume' Report of the Hero Type of Canister Test. Sept 26, 1918. Fieldner & Collette.	324
636. Progress Report for Sept 1918. Fieldner.	330
637. Progress Report for Aug 1918. Fieldner.	336

GMR 14: Reports 638-655, Part I, A.C. Fieldner, Oct 1918

638. Facilities and Conditions for testing Masks. Oct 7, 1918. Fieldner and Teague.	1
639. Protection afforded by Standard U.S. Army Canisters against Mixtures of C.C. and C.G.. Yoe, Rowland and Bailey. Oct 28, 1918.	11
640. Report on the Efficiency of Two One-Hour Rescue Canisters against CO ₂ . Oct 8, 1918.	24
641. Comparison of the American Canister Type H and J with French and German Canisters. Oct 7, 1918. Fieldner and Yoe.	27
642. Report on Man Test with HC#200. Oct 10, 1918. Yoe and Kuebler.	34
643. Comparison of Recent Foreign and American Canisters. Oct 5, 1918. Fieldner and Teague.	39
644. Method of Testing the Efficiency of Canisters against X ₁ and X ₂ . Oct 14, 1918. Yoe and Nelson.	56
645. The Effect of Periods of Rest on the Life of the Standard U.S. Army Canisters Type H against G-25 and G-52. Oct 14, 1918. Yoe and Pease.	61
646. Report on the Condition of Army Canisters withdrawn from Training Camps. Oct 14, 1918. Yoe and Pease.	73
647. Protection afforded by the Standard U.S. Army and German Canisters against Acetyl Chloride. Oct 8, 1918. Yoe and Nelson.	86
648. Results of Canister Tests against Samples of Whetlerite against CG and CC. Oct 17, 1918. Yoe and Pease.	92
649. Protection afforded by Standard U.S. Army Canisters against C ₆ H ₆ . Oct 18, 1918. Yoe and Benton.	108
650. A Rapid Method of Testing Canisters against the Mixed Vapors of Two Liquids. Oct 17, 1918. Benton.	114
651. Comparison of British and American Intermittent Machine Tests	

American University Technical Reports

on Type H, U.S. Canisters. Oct 25, 1918. Yoe and Pease.	120
652. Protection afforded by Standard U.S. Army and German Canisters against X ₁ and X ₂ . Oct 22, 1918. Yoe and Nelson.	128
653. Development of the Ammonia Canister No. 1. Yoe and Kuebler.	136
654. Protection afforded by various Canisters against Toxic Gases. Oct 26, 1918. Fieldner, Yoe and Pease.	142
655. Protection afforded by Proposed Industrial Canisters against Various Gases. Fieldner, Yoe and Pease. Oct 30, 1918.	157

GMR 14: Reports 656-675, Part II, A.C. Fieldner, Oct 1918

656. Protection afforded by Standard U.S. Army Canisters against Binary Mixtures of P.S. with G-28, C.G., SO ₂ , S-4, G-43 and C.C. Yoe and Charlton. Oct 28, 1918.	166
657. A Protection afforded by Standard U.S. Army Canisters against Binary Mixtures of C.G. with G-28 and with SO ₂ . Yoe and Rowland. Oct 28, 1918.	
658. A Protection afforded by Standard U.S. Army Canisters against Binary Mixtures of C.C. with G-28 and with SO ₂ . Yoe and Rowland. Oct 28, 1918.	190
659. Variability of Canisters as Determined by Man Tests. Oct 8, 1918. MacFarlane.	197
660. Resume' Report of Routine Tests of the Man Test Unit, Sept 25 to Oct 10, 1918. Gephart and Rowe. Oct 18, 1918.	210
661. Protection afforded by Various Canisters against G-76 Detonated in the Bomb Pit. Oct 14, 1918. Supple and Jordy.	213
662. Methods of Analysis of Gas Mixtures used in the Man Test Laboratories. Oct 14, 1918. Gephart, Supple and Rising.	219
663. Resume' Report on the Man Test Section. Oct 10-25, 1918. Oct 26, 1918. Gephart.	227
664. Resume' Report of the Absorbent Testing Unit. Sept 25 – Oct 10, 1918. Oct 11, 1918. Oberfell, Shinkle and Miller.	229
665. Comparison of the American University and Astoria Tube Tests Results from Aug 30 – Sept 22, 1918. Oct 14, 1918. Oberfell, Shinkle and Miller.	237
666. Resume' of the Absorbent Testing Unit, Oct 10-25, 1918. Oct 26, 1918. Oberfell, Shinkle and Miller.	249
667. Effect of Temperature on the Absorption Value of Charcoal for G-7. Oct 22, 1918. Oberfell and Shobe.	256
668. Investigation for Na ₂ O ₂ Method for P.S. Analysis. Oct 25, 1918. Oberfell and Gortner.	262
669. The Effect of Steam Activation on Service Time of Charcoal against P.S., C.G., G-178 and G-43. Oct 3, 1918. Oberfell, Shinkle and Miller.	269
670. Selenious Acid Method Detector for G-34. Oct 2, 1918. Yablick and Perrott.	278
671. Resume' of Protective Fabrics for Gas Masks and Protective Clothing. Oct 10, 1918. Perrott.	284
672. Quantitative Estimation of Traces of G-34 in Air. Oct 14, 1918. Furman, Perrott and Yablick.	287
673. The Effect of Exposure to the Weather on Rubber Mask Fabrics. Oct 9, 1918. Perrott and Plumb.	295
674. Permeability of Biscuit Containers against H.S. Oct 26, 1918.	

American University Technical Reports

Perrott and Franz.	312
675. S-4 Absorbents. Oct 28, 1918. Perrott and Yablick.	317

GMR 14: Reports 676-698, Part III, A.C. Fieldner, Oct 1918

676. Optimum Size of Absorbents in Low Resistance Canister. Oct 4, 1918. Beattie, Lang & Hyslop.	323
677. Optimum Size of Absorbents in Low Resistance Canister. #2. Oct 7, 1918. Fieldner, Beattie and Lang.	333
678. Protection against Hydrogen Sulfide. Oct 15, 1918. Beattie and Helgeson.	342
679. The Effect of Temperature on the Absorption of G-52, 25, 43, and G-178. Oct 3, 1918. Katz, Cox and Gladstein.	348
680. The Effect of Temperature on the Absorption of G-43. Oct 7, 1918. Katz, Cox and Gladstein.	356
681. The Effect of Temperature on Absorption of G-43 by Soda Lime and Comparative Effects on Charcoal and Type H, U.S. Army Canisters. Oct 28, 1918. Katz, Cox and Gladstein.	364
682. Protection afforded by Various Canisters against G-76 Candles in the Conduit Road Field Test. Oct 7, 1918. Supple and Jordy.	377
683. Protection of Various Cans against Mixtures of G-76 and G-52 Detonated in the Bomb Pit. Oct 10, 1918. Supple and Jordy.	387
684. Protection afforded by Various Canisters against D.A. shells in Tests at Bradley Field. Oct 16, 1918. Oct 25, 1918. Supple and Jordy.	394
685. Protection afforded by Various Canisters against Mixtures of D.A. and C.G. Detonated in Field Test Oct 19, 1918. Oct 26, 1918. Supple and Jordy.	408
686. Field Test on German Masks. Oct 28, 1918. Jordy.	416
687. Protection afforded by Various Canisters against Mark 2 Gas Grenades Detonated in Bomb Pit. Oct 18, 1918. Oct 25, 1918. Supple and Jordy.	429
688. Protection afforded by Various Canisters against Pure and Impure D.M. Candles at Bradley Field. Oct 23, 1918. Oct 26, 1918. Supple and Gephart.	436
689. Report on the Navy Head Mask Canister. Oct 2, 1918. Collette.	442
690. Comparison of German and American Canisters. Oct 2, 1918. Fieldner and Collette.	445
691. Report on Logan Canister. Oct 4, 1918. Fieldner and Collette.	450
692. Report on the Logan Canister. Oct 25, 1918. Fieldner and Collette.	457
693. Resume' Reports of the Routine Canister Tests. Sept 26 – Oct 10, 1918. Oct 14, 1918. Collette.	469
694. Daily Control Tests on Hero and L.I. Canisters. Oct 14, 1918. Fieldner and Collette.	473
695. Resume' Reports of the Routine Canister Tests Oct 11 – 25, 1918. Collette.	477
696. Daily Control Tests of Hero and L.I. Canister filled from Oct 2 to 21, 1918. Oct 28, 1918. Fieldner and Collette.	481
697. Method of Testing Filters against Tobacco Smoke. Oct 2, 1918. Arnold and Longfellow.	485
698. Method of Testing Filtering Efficiency of Canisters against a Standard Sulfuric Acid Smoke. Oct 18, 1918. Reese and Thayer.	495

GMR 15: Reports 699-723, Part I, A.C. Fieldner, Nov 1918

699. Equations for the Conversion of Routine Canister Tests of the American University Experimental Station into terms of the Long Island Tests. Nov 1, 1918. Fieldner and Yoe.	1
700. Method of Testing the Efficiency of Canisters against 2-4 Dichlorobenzyl Bromide. Nov 2, 1918. Yoe and Nelson.	7
701. Protection afforded by Standard U.S. Army Canisters against 2-4 Dichlorobenzyl Bromide. Nov 15, 1918. Yoe and Nelson.	12
702. Protection afforded by Standard Type H U.S. Army Canisters containing Whetlerite against C.G. and C.C.. Nov 18, 1918. Yoe and Pease.	17
703. Protection afforded by Standard U.S. Army Canisters against Mixtures of P.S. and S-22. Yoe and Charlton. Nov 4, 1918	45
704. Method of testing the efficiency of Canisters against Diphenyl-cyanoarsine. Powell, Nelson and Allen. Nov 20, 1918.	52
705. Concentration-Time-Rate-Relation of C.G. with Standard Type H and Type J, U.S. Army Canisters. Yoe and Pease. Nov 7, 1918.	59
706. Report on the Efficiency of an improved Rescue Canister (Modified Gibbs). Fieldner and Yoe. Nov 23, 1918.	73
707. Protection afforded by Standard U.S. Army Canisters against D.V. and low concentrations of G-34. Yoe and Nelson. Nov 22, 1918.	76
708. Report of attempts to incapacitate the Enemy Canisters. Yoe and Benton. Nov 11, 1918.	83
709. Protection afforded by Standard U.S. Army Canisters against Binary Mixture of G-10 with C.C. and C.G.. Nov 19, 1918. Yoe and Rowland.	95
710. Monox as a Smoke Absorbent. Pease and Maloney. Nov 23, 1918.	103
711. Comparison of continuous and intermittent Machine Tests against C.C.. Nov 18, 1918. Yoe and Maloney.	107
712. Condition of Training Camp Canisters withdrawn from service. Nov 23, 1918. Yoe and Pease.	112
713. A Study of Gas Mixtures from an Offensive Standpoint. Nov 19, 1918. Yoe.	122
714. Summary Report on Salvus Carbon Dioxide Canisters. Nov 25, 1918. Fieldner & Yoe.	140
715. Summary Report on Gibbs Rescue Apparatus Canisters. Nov 25, 1918. Fieldner & Yoe.	146
716. Data on Field Concentrations of Toxic Substances. Nov 26, 1918. Pease.	153
717. Protection afforded by U.S. Army and Foreign Canisters against C.C. alone and in Mixtures with other Gases. Yoe and Rowland. Oct 26, 1918.	169
718. Resume' Report of the Routine Tests of the Man Test Unit, Oct 25 to Nov 10, 1918. Nov 11, 1918. Gephart and Catherman.	187
719. Resume' Report of the Routine Tests of the Man Test Unit, Nov 10 to 25, 1918. Nov 25, 1918. Gephart and Catherman.	192
720. Application of the Volhard Method for the determination of CN content in C.C. alone and in Mixtures with C.G. or P.S. and methods of manipulation. Nov 18, 1918. Rising, Supple and Gephart	195
721. Test of accuracy on Evacuated Bottle fitted with Capillary Tubes	

American University Technical Reports

for Gas Sampling. Nov 30, 1918. Gephart and Langdon.	204
722. Series Tube Absorber. Nov 21, 1918. Oberfell, Shinkle and Meserve.	209
723. Examination of German Respirators received at the American University Experiment Station, Sept 19, 1918. Oberfell, Outcault & Hammerle. Nov 10, 1918.	218

GMR 15: Reports 724-743, Part II, A.C. Fieldner, Nov 1918

724. Resume' Report of the Absorbent Testing Unit, Oct 25 to Nov 10, 1918. Oberfell, Shinkle and Miller. Nov 12, 1918.	265
725. Comparison of American University Experiment Station and Astoria, Long Island Tube Test Results from Sept 23 to Oct 22, 1918. Oberfell, Shinkle and Miller. Nov 12, 1918.	272
726. A Mechanical Device for filling Absorption Tube. Nov 12, 1918. Mase.	285
727. Relation between Canister Tests and Tube Tests of Charcoals and Whetlerites against Cyanogen Chloride. Nov 25, 1918. Oberfell and Mase.	298
728. A Comparison of Hoolamite and Palladium Chloride Carbon Monoxide Tests. Oberfell and Ruby. Nov 6, 1918.	309
729. A Study of Absorbents for Cyanogen Chloride. Oberfell and Depew. Nov 30, 1918.	315
730. Optimum Mixture of "Gellite" charcoal, and Soda Lime for Gas Mask Absorbents. Oberfell and Mullen. Dec 5, 1918.	330
731. Resume' Tests of Fabrics for Gas Masks and Protective Clothing. Nov 12, 1918. Perrott.	336
732. The Kupramite Ammonia Canister. Perrott and Yablick. Nov 15, 1918	339
733. Resume' of Tests of Fabrics for Gas Masks and Protective Clothing. Nov 26, 1918. Perrott and Ferguson.	346
734. Tests on New Horse Mask. Factor between Resistance to P.S. and H.S.. Nov 25, 1918. Perrott and Greensfelder.	350
735. Optimum Grain Size of Absorbents in Low Resistance Canisters. Report No. 3. Beattie, Lang and Hyslop. Nov 15, 1918.	354
736. Optimum Grain Size of Absorbents in Central Breathing-Tube Canisters. Report #1. Nov 20, 1918. Beattie, Lang and Hyslop.	361
737. Revised Logan Canister. Fieldner and Beattie. Nov 24, 1918.	369
738. Optimum Grain Size of Absorbents in Central Breathing-Tube Canisters. Report #2. Beattie, Lang and Hyslop. Nov 30, 1918.	381
739. Protection afforded by Soda Lime and Charcoal, when mixed and when separated in Various Layers, against C.G., G-43 and P.S. Nov 29, 1918. Beattie.	392
740. Colorimetric estimation of Arsine in air. Nov 9, 1918. Crites and Wilson.	403
741. Effect of Temperature on Absorption of G-178 by Whetlerite. Nov 19, 1918. Katz, Cox and Gladstein.	412
742. Protection afforded by various Canisters against D.M. Candles in Field Test at Berlin, MD, Nov 2, 1918. Fieldner, Supple, Jordy and Burton. Nov 6, 1918.	422
743. Protection afforded by various Canisters against the Two Types of D.A. Candles designed by the Pyrotechnic and Dispersoid Section. Field Test at Montgomery County Country Club, Oct 30,	

1918. Supple and Jordy. Nov 5, 1918.	435
--------------------------------------	-----

GMR 15: Reports 744-764, Part III, A.C. Fieldner, Nov 1918

744. Protection afforded by Various Canisters against D.A. Smoke Shells at Lakehurst, NJ Proving Grounds, Nov 20-22, 1918. Supple, Jordy and Burton. Nov 26, 1918.	451
745. Comparison of American University Experiment Station and Gas Defense Tests on Hero and L.I. Canisters. Collette. Nov 5, 1918.	460
746. Resume' Report on Routine Canister Tests, Oct 26 to Nov 10, 1918. Nov 15, 1918. Collette.	465
747. Daily Control Tests, Hero and L.I. Type L Canisters filled from Oct 22 to Nov 1, 1918. Nov 12, 1918. Fieldner & Collette.	469
748. The efficiency of Runal's, Type 15, Low Resistance Canister. Nov 15, 1918. Fieldner and Collette.	472
749. The effect of reversing the Flow of Gases through Canisters. Nov 15, 1918. Collette and Henley.	481
750. A Multiple Machine for testing Canisters against Chloropicrin at Intermittent Flow. Collette, Gephart and Doutt. Nov 16, 1918.	486
751. Standard Intermittent Mechanical Value. Collette and Gephart. Nov 16, 1918.	495
752. Daily Control Tests on Hero and Long Island Canisters filled from Nov 2 to Nov 14, 1918. Nov 14, 1918. Fieldner and Collette.	500
753. Resume' Report of Routine Canister Tests. Nov 25, 1918. Collette.	504
754. Comparison of American University Experiment Station and Gas Defense Tests on Hero and Long Island Canisters. Nov 26, 1918. Collette.	507
755. Investigation of the effect of Moisture on U.S.B.R. against C.G. Nov 8, 1918. Collette, Saylor and Howe.	512
756. Investigation of the Penetration of Cover Cartridges by Diphenyl-chloroarsine. Nov 15, 1918. Arnold and Horton.	527
757. Preliminary Report on an Optical Penetrometer for measuring the Efficiency of Smoke Filters. Nov 15, 1918. Arnold and Wells.	532
758. Use of the Eastman Duplex Photometers for measuring the Filtering Efficiency of Canisters. Arnold. Nov 25, 1918.	539
759. The Efficiency of Several Papers against Ammonium Chloride Smoke as determined by Means of the Optical Penetrometer. Arnold. Nov 25, 1918.	546
760. Tests on Standard Canisters with and without Cover Cartridges against Ammonium Chloride Smoke. Arnold. Nov 27, 1918.	552
761. Method of Testing the Filtering Efficiency of Canisters against Tobacco Smoke. Nov 18, 1918. Arnold, Horton & Longfellow.	593
762. A Study of the Variables involved in testing Filtering Materials against a Standard Tobacco Smoke. Nov 29, 1918. Teague, Rees and Longfellow.	562
763. Important accomplishments of the Gas Mask Research Section. Nov 7, 1918. Fieldner.	582
764. Progress Report for Oct 1918. Fieldner. Nov 6, 1918.	585

GMR 16: Reports 765-782, Part I, A.C. Fieldner, Dec 1918 & Jan 1919

765. Effect of Temperature on Absorption of various Gases as shown

by Canister Tests and Tube Tests. Katz and Yoe. Nov 27, 1918	1
766. Concentration-Time Relation for 100% Charcoal Canisters against Carbon Tetrachloride. Yoe, Nelson and Minnig. Dec 2, 1918.	8
767. Method of Testing and Protection afforded by Canisters against Gasoline. Yoe, Nelson and Powell. Dec 5, 1918.	15
768. Concentration-Time Relation and Temperature Coefficient of Absorption of C.C. by Canisters packed with Charcoal. Yoe and Pease. Dec 10, 1918.	21
769. Method of Testing and Protection afforded by Canisters against Hydrogen Chloride. Yoe and Pease. Dec 18, 1918.	30
770. Concentration-Rate-Time Relation for Standard Types H and J, U.S. Army Canisters against P.S. Yoe, Pease and Mentzel. Dec 15, 1918.	36
771. Development Work on the Navy Head Type Canister. Pease. Dec 22, 1918.	45
772. Method of Testing and Protection afforded by Canisters against the Chlorides of Sulfur. Powell, Rowland and Nelson. Dec 16, 1918.	54
773. Method of Testing and Protection against Aniline. Yoe and Maloney. Dec 26, 1918.	65
774. Report of Tests with Garnett Smoke Filter against Ammonia vapor and smoke from combustion of Damp Straw and Wood. Fieldner. Dec 11, 1918.	69
775. The development of the Army Carbon Monoxide Canister. Yoe and Kuebler. Dec 28, 1918.	73
776. Special Studies in Connection with CMA-3 Canisters. Containing HL-I and HL-II. Yoe and Kuebler. Dec 29, 1918.	80
777. The Development of Ammonia Canister No. 2. Yoe, McCarthy, and Kuebler. Jan 4, 1919.	93
778. The Relation of the Efficiency of Canisters and Absorbents to the Concentration of Gas and the Rate and Character of Flow. Pease and Yoe. Dec 27, 1918.	106
779. Summary Report of Carbon Monoxide Canister. Yoe. Dec 30, 1918.	127
780. Optimum Canister Filling with HC. Yoe, Kuebler and McCarthy. Jan 3, 1919.	132
781. Method of Testing and Protection afforded by Canisters against Ethyl Chloride. Yoe and Charlton. Dec 31, 1918	137
782. Resume' Comparison of Protection afforded by different Canisters against Various War Gases. Yoe and Charlton. Jan 25, 1919.	144

GMR 16: Reports 783-800, Part II, A.C. Fieldner, Dec 1918 & Jan 1919

783. Effect of changing the Relative Portions of the Canister and Filter on the Fogler Flat Felt Filters. Dec 2, 1918. Gephart and Sprague.	212
784. Penetration of Various Types of Filters against a Mixture of D.A. and C.G. Dec 4, 1918. Balch and Gephart.	216
785. Resume' Report of Routine Tests of the Man Test Unit, November 25 to December 10, 1918. Dec 10, 1918. Gephart and Catherman.	221
786. Efficiency of Type J Canisters against Various Gases. Dec 3, 1918. Gephart, Supple and MacFarlane.	224
787. Microscopic Examination of Coconut Charcoal. Dec 4, 1918. Reinhardt Thiessen.	232

788. Resume' Report of the Absorbent Testing Unit, November 10 to November 25, 1918. Dec 4, 1918. Oberfell, Shinkle and Miller.	278
789. A Proposed Accelerated Cyanogen Chloride Tube Test Method for Charcoals. Dec 2, 1918. Oberfell and Mase.	284
790. The Action of Cyanogen Chloride on Various Gas Mask Absorbents. Dec 12, 1918. Oberfell and Ruby.	291
791. Resume' Report of the Absorbent Testing Unit, November 25 to December 10, 1918. Dec 15, 1918. Oberfell, Shinkle and Miller	297
792. Relation between Canister Tests and Tube Tests of Charcoal and Whetlerite against Chloropicrin. Dec 11, 1918. Oberfell and Gortner.	302
793. Optimum Mixture of "Gellitte" Charcoal and Soda Lime for Gas Mask Absorbents. Dec 5, 1918. Oberfell and Mullen	314
794. Comparison of American University and Astoria Tube Test Results from October 23 to November 24, 1918. Dec 9, 1918. Oberfell, Shinkle and Miller.	320
795. The Effect of Trichloromethyl Chloroformate Tube Test Results of a Proportionate Decrease in the Absorbent Column Height and Rate of Flow. Dec 14, 1918. Oberfell and Voress.	334
796. The Effect of Cyanogen Chloride Tube Test Results of a Proportionate Decrease in the Absorbent Column Height and the Rate of Flow. Dec 2, 1918. Oberfell and Mase.	343
797. The Action of Chlorine on Various Gas Mask Absorbents. Dec 18, 1918. Oberfell and Mullen.	351
798. Relation between accelerated Chloropicrin and Carbon Tetrachloride service times of Absorbents. Dec 20, 1918. Oberfell, Shinkle and Pabst.	360
799. Investigation of the so-called "Break Point" of Filters against D.A. Dec 2, 1918. Mullen.	370
800. Impregnation of Filters with Oxidizing of Catalytic Agents for Protection against D.A. Dec 10, 1918. Mullen.	378

GMR 16: Reports 801-813, Part III, A.C. Fieldner, Dec 1918 & Jan 1919

801. Comparison of Foreign and American Gas Mask Absorbents. January. Oberfell, Shinkle and Miller.	384
802. The Effects of Aging and Humidity upon Absorbents and Canisters. Dec 18, 1918. Oberfell and Shinkle.	455
803. Renovation of Fabrics Contaminated with H.S., Preliminary Report. Dec 5, 1918. Perrott, Yablick and Ferguson.	559
804. Quantitative Estimation of H.S. in Air Mixtures. The Quartz Tube Iodine Method. Dec 2, 1918. Perrott and Sheppard.	564
805. Standard Method of Testing Permeability of Fabrics to H.S. Dec 2, 1918. Perrott and Sheppard.	569
806. Renovation of Fabrics Contaminated with H.S. Dec 4, 1918. Perrott, Yablick and Marsh.	576
807. Impregnating Oils for Dugout Blankets. Dec 2, 1918. Perrott and Feld.	584
808. Specifications for Gasoline-Smoke-Ammonia Canister as Recommended by the Research Division of the Chemical Warfare Service. Dec 31, 1918. Perrott.	590
809. A Field Impregnating Apparatus for Dugout Curtains. Jan 4, 1919. Perrott and Feld.	592

American University Technical Reports

810. Dugout Protection. Jan 11, 1919. Perrott and Yablick.	595
811. A New Absorbent for Ammonia Respirator. Complete Report. Jan 10, 1918. Perrott and Yablick.	620
812. Quantitative Estimation of Traces of Dichloroethyl Sulfide (Mustard Gas) in Air. A Nephelmetric Method using Selenious Acid. Complete Report. Jan 23, 1919. Yablick, Perrott and Plumb.	637
813. Effect of Moisture Content on the Permeability of Fabrics to H.S. Jan 28, 1918. Clewes, Perrott, Gordon and Greensfelder.	649

GMR 16: Reports 814-827, Part IV, A.C. Fieldner, Dec 1918 & Jan 1919

814. Course of Gases through Canisters at Different Rates of Flow and at Intermittent and Continuous Flow. Dec 18, 1918. Beattie and Helgeson.	655
815. Summary of Theoretical work on Canister Filling and Design. Jan 21, 1919. Fieldner and Beattie.	662
816. Evolution of Standard Army Canister. Jan 18, 1919. Beattie.	682
817. Effect of Temperature on Absorption of C.G. by Charcoal. Dec 21, 1918. Katz, Shively and Kitchen.	689
818. Protection afforded by Various Canisters against D.A. and D.M. Candles at Lakehurst (NJ). Dec 18, 1918. Supple, Jordy, and Burton.	699
819. Comparative Tests of two types of Canisters for Protection against Ammonia Gas. Dec 31, 1918. Jordy.	706
820. Field Tests of the K.M.T. Masks. Jan 7, 1919. Jordy and Van Velzer	714
821. Accelerated Service Tests of Logan Canisters and Several Types of Masks. Dec 31, 1918. Jordy.	728
822. Field Tests of Miller Ventilating Masks. Jan 10, 1919. Jordy and Van Velzer.	739
823. Determination of Breathing Rates of Different Members of the Field Test Unit. Jan 17, 1919. Jordy.	751
824. Field Tests on Pierce Lakeside Masks. Jan 11, 1919. Jordy.	760
825. Summary Reports of Routine Standard Tests. Jan 20, 1919. Jordy and Van Velzer.	771
826. Development of a Canister for Determining Breathing Rates in Road Tests. Jan 18, 1919. Jordy and Van Velzer.	802
827. Summary of Work Conducted to Establish the Relative Protection afforded by Various Canisters under Field Conditions. Dec 20, 1918. Fieldner, Burton and Supple.	810

GMR 16: Reports 828-844, Part V, A.C. Fieldner, Dec 1918 & Jan 1919

828. Report on English Canisters. Fieldner, Collette & Henley. Dec 4, 1918.	840
829. A Duplex (64 L/M) Canister Testing Machine for Phosgene, Chloropicrin and Hydrogen Cyanide. Collette, Henley and Bopst.	849
830. The Canister Testing Laboratory. Collette. Jan 7, 1919.	857
831. The Relation between Intermittent and Continuous Machine Tests. Henley and Collette. Jan 8, 1919.	888
832. Investigation of the Effect of Variables on the Filtering Effi- ciency of Paper against Ammonium Chloride Smoke. Arnold and	

Outcault. Dec 2, 1918.	900
833. An Optical Penetrometer for Determining the Efficiency of Filters. Arnold and Wells. Dec 18, 1918.	909
834. Investigation of the Size of Box used in the Optical Penetrometer. Arnold, Outcault and Flory. Dec 14, 1918.	914
835. Standard Smoke Tests for Determining Filtering Efficiency of Canisters and Protection against Toxic Smokes. Teague and Rees. Dec 30, 1918.	919
836. Preliminary Study of the "Break Point" Method of Rating Filters and the Effect of Rate of Flow upon Filtering Efficiencies. Jan 7, 1919.	930
837. Man and Machine Smoke Tests on Papers in Frames and Flanges. Teague, Rees and Werthan. Jan 20, 1919.	937
838. Summary of Smoke Testing in Gas Mask Research Section. Teague and Rees. Jan 20, 1919.	945
839. Progress Report for Month of November. Fieldner.	962
840. Progress Report of the Gas Mask Research Section. Dec 31, 1918.	977
841. History of the Gas Mask Research Section, Research Division, Chemical Warfare Service, U.S.A.. Fieldner and Benton. Jan 14, 1919.	

Appendix

842. Report on Pressure Drop through French Tissot (small) Canister. Teague.	1
843. Methods of Analysis for Toxic Gases used by the Gas Mask Research Section. Fieldner and Teague.	3
844. Effect of Temperature on Absorption of C.G. by Soda Lime and Comparative Effects on Charcoal and Type H, U.S. Army Canisters. Katz, Shively and Kitchen. Jan 2, 1919.	16

GMR 17: Index and Table of Contents for Volume I to XVII, compiled by Sgts. Scull, Longfellow, and Warren

GMR 20: Summary of Achievements 1917-1918, A.C. Fieldner [2 copies]

1. Methods of testing gas mask absorbents.	1
2. Absorption values of various gas mask absorbents.	1
3. Absorbents for CC.	1
4. Methods of testing the efficiency of canisters against various gases.	2
5. Protection afforded by various canisters against toxic gases.	3
6. Protection afforded by foreign canisters against various gases.	3
7. Improvements in the Navy drum.	4
8. Testing of Carbon Dioxide canisters.	7
9. Development of Carbon Monoxide canisters.	8
9a. Development of canister for protection against Ammonia.	10
10. Offensive value of various gas mixtures.	12
11. Effect of temperature on the efficiency of canisters against various gases.	16
12. Effect of temperature on the absorbing power of various absorbents.	16
13. Effect of humidity and aging on canisters and absorbents.	17
14. Relation of concentration of gas to the life of standard canisters and absorbents.	19
15. Relation between rate of flow and life of standard canisters.	21

16. Comparison of continuous and intermittent machine tests and man tests on standard canisters.	22
17. Standard canister filling and design.	25
18. Methods of testing gas mask fabrics and protective clothing.	30
19. Routine permeability tests of mask fabrics and protective clothing.	30
20. Development of protective coatings for fabrics.	30
21. Renovation of fabrics contaminated with HS.	31
22. Effect of exposure to weather on fabrics.	32
23. Mechanism of fabric penetration.	33
24. Dugout protection.	35
25. Comfort, fit and general wearing properties of masks.	37
26. Smoke testing.	40
27. Field penetration tests.	44
28. Impregnation and testing of horse masks.	50
29. Stabilization of G-4.	50
30. G-34 field detectors.	50
31. Detection of Hydrogen in submarine atmospheres.	51
32. Estimation of Arsine in air.	51
33. Portable Orsat gas analysis apparatus	51
Appendix –	
Table I	52
Table II	60
Table III	71
Table IV	74

GMR: Reports 699-A: A.C. Fieldner, October 26, 1918

699-A. Protection afforded by various canisters against toxic gases: Fieldner, Yoe, and Pease

GMR: Reports 700-A: A.C. Fieldner, October 30, 1918

700-A. Protection afforded by proposed industrial canisters against various gases: Fieldner, Yoe, and Pease

PHARMACOLOGICAL AND RESEARCH SECTION (PR) :

PR 1: Reports 1-50, E.K. Marshall

1. Apparatus and Method for studying the Pharmacological Effects of the Vapors of Liquids upon Animals: Marshall and Kolls	1
2. Apparatus and Method for testing Toxicity on Mice: Marshall and Haggard	4
3. Toxicity Experiments on Mice: Marshall	7
4. Chlorine – Toxicity: Marshall	22
5. Analytical Procedures for estimating the Concentrations of Perchloro-methylchloroformate, Methylchloroformate and Ethylchloroformate in air: Marshall and Satler	38
6. Pathology of Mustard Gas Poisoning: Mackenzie	40
7. Toxicity of Perchloromethylchloroformate: Marshall	64
8. Toxicity of Tests of 11 Compounds on Mice and Toxicity Tests with Cyanogen Bromide on Dogs: Marshall	87
9. Method of Expressing Concentrations: Marshall	93
10. Report on Seeds (Sabadilla Seed, Gum Euphorbium, Oleoresin,	

Capsicum and Fluid Extract Capsicum) submitted from Ohio State University	96
11. Toxicity Experiments on Mice with 15 Compounds: Kolls, Kuhn and Todd	98
12. Comparison of the Toxicity and Action of Chlorine, Phosgene, Superpalite, Chloropicrin and Hydrocyanic Acid on Dogs: Marshall	106
13. Toxicity of Perchlormethylchloromate on Cats and Dogs: Marshall and Kolls	107
14. Toxicity of Phosgene on Dogs: Marshall and Hanson	110
15. Toxicity of Chloropicrin on Dogs: Marshall and Miller	112
16. Toxicity of Hydrocyanic Acid on Dogs: Marshall and Hanson	114
17. Skin Irritants: Kolls and Gilbert	116
18. Ethylbromoacetate (Analyzing of Air Mixture): Satler	120
19. Procedure for estimation of G-67 in Air Mixtures – also Ethyl-iodoacetate: Satler	122,123
20. Preliminary Report on Dog Masks: Kolls	124
21. Toxicity Tests on Mice: Kolls, Kuhn and Todd	125
22. Toxicity of G-34 on Dogs: Marshall & Miller	133
23. Toxicity of G-40 on Dogs: Miller and Hopkins	137
24. Toxicity of G-55 on Dogs: Miller and Hopkins	140
25. Toxicity of G-67 on Dogs: Miller and Hopkins	142
26. Toxicity of G-100 on Dogs: Miller and Hopkins	145
27. Toxicity of Steam Distillate of G-103 on Dogs: Miller and Hopkins	148
28. Toxicity of G-160 on Dogs: Miller and Hopkins	150
29. Toxicity of G-187 on Dogs: Miller and Hopkins	151
30. Physiological Testing of Gas Masks: Sherwood and Snyder	154
31. Physiological Testing of Absorbents against various Gases and Mustard Oil: Crowell	161
32. Summary of Bi-Monthly Report (Jan 15, 1918)	164
33. Toxicity Tests on Mice with Seven Compounds: Kolls, Kuhn and Todd	166
34. Toxicity of G-4 on Dogs: Miller	170
35. Skin Irritants: Kolls and Gilbert	173
36. Shell Tests on Animals	185
37. Pathological Anatomy of Poisoning by Gases: Mackenzie	186
38. Physiological Testing of Gas Masks: Sherwood and Snyder	194
39. Tests on Man with Various Gases for determining Lachrymatory Power: Sherwood and Snyder	196 A
40. Bi-Monthly Report: Marshall (Feb 1, 1918)	199
41. Toxicity Tests on Mice with 7 Compounds: Kolls, Kuhn and Todd	201
42. Toxicity of G-7 on Dogs: Miller and Hopkins	205
43. Toxicity of G-103 (alpha Isomer) on Dogs: Miller and Hopkins	208
44. Toxicity of G-103 on Dogs: Miller and Hopkins	210
45. Toxicity of G-103 (Pure) on Dogs: Miller and Hopkins	212
46. Toxicity of G-178 on Dogs: Miller and Hopkins	214
47. Physiological Tests on Man (Apparatus): Sherwood and Snyder	217
48. Physiological Tests on Man : Sherwood and Snyder	219
49. Physiological Tests on Man (Experiments of brom methyl ethyl ketone): Sherwood and Snyder	221
50. Physiological Tests on Man (Bromobenzyl cyanide): Sherwood and Snyder	223

51. Physiological tests on man with Kendallite: Sherwood and Snyder	1
52. Physiological tests on man with Ethyl Iodo Acetate: Sherwood and Snyder	3
53. Method of analysis for low concentrations of Arsine: Satler	5
54. Method of analysis for low concentration of G-178 and G-343: Satler, Wible & Beaver	7
55. Method of analysis of G-313 for purity and for low concentration: Satler	10
Analytical method for determining G-139 in air mixtures: Satler and Beaver	11a
56. Bimonthly report Feb 15 th , 1918.	12
57. Toxicity scales – Mice – Dogs – Lachrymators	15
58. Comparison and Summary of physiological data on Dichloroethyl Sulfide, Dichlor-Propyl Sulfide and related substances: Marshall and Kolls	18
59. Toxicity of G-349 and G-70 on mice: Kuhn & Todd	24
60. Toxicity experiments with Phenyl dichloroarsine on Dogs: Miller and Hopkins	32
61. Toxicity of G-76 on dogs: Miller & Hopkins	35
62. Toxicity of "British Preparation" of G-34 on dogs: Miller and Hopkins	37
63. Toxicity of G-31 on dogs: Hanson	40
64. Description of G-31 Apparatus: Hanson	41
65. Toxicity of Dichloropropyl sulfide (pure steam distillate) on dogs: Miller & Hopkins	42
66. Toxicity of Dichloropropyl sulfide (beta isomer) on dogs: Miller & Hopkins	45
67. Toxicity of G-205 on dogs: Miller & Hopkins	48
68. Toxicity of Monochloroethyl Sulfide on dogs: Miller & Hopkins	50
69. Toxicity of Arsenic Trifluoride on dogs: Miller & Hopkins	51
70. Physiological tests with G-16 on man: Sherwood and Snyder	54
71. Physiological tests with G-25 on man: Sherwood and Snyder	56
72. Physiological Testing of Absorbents and Canisters: Gilbert	59
73. Method of analysis of G-76: Satler and Wible	68
74. Method of analysis of G-349 for purity and low concentration: Satler and Wible	70
75. Experiments on the decomposition of Arsenic Trifluoride in moisture: Satler & Wible	72
76. Decomposition of Arsenic Trifluoride in air mixtures: Satler and Wible	75
77. Toxicity of Ethyl Chloroacetate and Meta Dinitro Phenetol on mice: Kuhn and Todd	77
78. Toxicity of Superpalite on dogs (15 min. exposure): Miller & Hopkins	78
79. Toxicity of Superpalite on dogs (30 min. exposure): Miller & Hopkins	81
80. Toxicity of Superpalite on dogs (1 hr. exposure): Miller & Hopkins	84
81. Toxicity of Superpalite on dogs (2 hr. exposure): Miller & Hopkins	87
82. Toxicity of a mixture of G-34 and G-103 on dogs: Miller & Hopkins	89
83. Exposure of dogs to G-67 at Naval Proving Ground, Indian Head,	

MD: Kuhn	91
84. Exposure of dogs to G-67 at Naval Proving Ground, Indian Head, MD: Kuhn	92
85. Toxicity of Magnesium Arsenide on dogs exposed at Naval Proving Ground, Indian Head, MD: Kuhn	93
86. Toxicity of G-343 on dogs in bomb pit, Feb 16, 1918: Kuhn	95
87. Toxicity of G-343 on dogs in bomb pit Feb 18 th : Kuhn	96
88. Toxicity of Hexachloroethane on dogs in bomb pit: Kuhn	97
89. Toxicity of Bromcyanogen on dogs in bomb pit: Kuhn	99
90. Physiological tests with G-4 on man: Sherwood, Snyder and Gavin	100
91. Physiological tests on man with Superpalite: Sherwood and Snyder	102
92. Physiological tests on man with Butyl Mercaptan: Sherwood and Snyder	104
93. Physiological tests with Phenyl Dichloroarsine: Sherwood, Snyder and Gavin	106
94. Physiological testing of Absorbents and Canisters: Gilbert	109
95. Mice used as indicators on G-43 absorbent test: Kuhn	114
96. Toxicity of G-13 (special) on dogs: Sherwood and Snyder	116
97. Toxicity experiments with eight compounds on mice: Kuhn and Todd	118
98. Toxicity of Cyanuric Chloride on dogs: Miller and Hopkins	123
99. Toxicity of Superpalite on dogs (4 hr. experience): Miller and Hopkins	126
100. Toxicity of G-67 on dogs (15 min. experience): Miller and Hopkins	129

PR 3: Reports 101-150, E.K. Marshall

101. Toxicity of G-67 on dogs (30 min. exposure): Miller & Hopkins	1
102. Toxicity of G-67 on dogs (1 hour exposure): Miller & Hopkins	3
103. Toxicity of G-67 on dogs (2 hour exposure): Miller & Hopkins	6
104. Toxicity of G-337 on dogs: Miller & Hopkins	8
105. Dogs exposed to Chloropicrin in bomb pit: Kuhn	10
106. Dogs exposed to Bromobenzyl-Cyanide in the bomb pit: Kuhn	13
107. Dogs exposed to Hydrocyanic Acid in the bomb pit: Kuhn	14
108. Dogs exposed to Hydrocyanic Acid in the bomb pit: Kuhn	15
109. Dogs exposed to Phosgene in the bomb pit: Kuhn	16
110. Dogs exposed to Hexachloroethane at Naval Proving Ground, Indian Head, MD: Kuhn	17
111. Dogs exposed to Magnesium Arsenide at Naval Proving Ground, Indian Head, MD, 3-7: Kuhn	18
112. Dogs exposed to Bromobenzyl Cyanide at Naval Proving Ground, Indian Head, MD: Kuhn	19
113. Dogs exposed to Parazol at Naval Proving Ground, Indian Head, MD: Kuhn	20
114. Dogs exposed to Bromcyanogen at Naval Proving Grounds, Indian Head, MD: Kuhn	21
115. Pathology of poisoning G-76 (Dogs): Mackenzie Pathology of Diphenylchloroarsine: Mackenzie	22
116. Physiological tests on man to determine the smallest concentration of Phenyl Isocyanide: Sherwood & Snyder	25
117. Physiological tests on man to determine the smallest concentration of Phenyl Mustard Oil: Sherwood & Snyder	26
	28

118. Physiological tests on man to determine the smallest concentration of Capsicum: Sherwood & Gavin	29
119. Physiological tests on man to determine the smallest concentration of Allyl Sulfo Isocyanate: Sherwood, Snyder & Gavin	31
120. Determination of small amounts of Arsenic: Sharp	33
121. Method of analysis of Bromobenzyl cyanide: Satler & Wible	41
122. Method of analysis of the polymer (CN Cl) ₃ – (G-178) ₃ : Satler & Wible	42
123. Analysis of G-13 for purity and for low concentration in air mixture: Satler & Wible	44
124. Analysis of G-332, Monochloroacetone, and G-325, Chloromethylacetate, for purity of sample, and estimation of low concentrations in air mixtures: Satler	46-48
125. Toxicity tests on mice, Methyl Chlorosulfonate and Dichlorobenzyl Bromide: Kuhn & Todd	49
126. Toxicity of G-178 on dogs: Miller & Hopkins	50
127. Toxicity of Superalite on dogs (7½ min. exposures): Miller & Hopkins	52
128. Toxicity of G-7 on dogs (15 min. exposures): Miller & Hopkins	57
129. Toxicity of G-67 on dogs (7½ min. exposures): Miller & Hopkins	59
130. Toxicity of G-67 on dogs (4 hr exposures): Miller & Hopkins	65
131. Dogs exposed to Chloropicrin in bomb pit: Kuhn	69
132. Dogs exposed to Chlorcyanogen in bomb pit: Kuhn	70
133. Dog exposed to Sodium Cyanide in the detonating box: Kuhn	71
134. Dogs exposed to Sodium Cyanide in the detonating box: Kuhn	72
135. Pathology of poisoning by Arsine: Mackenzie	74
136. Action of Arsine on the blood: Mackenzie	84
137. Experiments to determine the effect of relatively high concentrations of Butyl Mercaptan on man: Sherwood & Snyder	87
138. Experiments to determine the smallest concentration of Ethyl Mustard Oil that can be detected by the eyes, nose, throat, or lower respiratory tract – on man: Sherwood & Snyder	88
139. Physiological testing of canisters and absorbents: Gilbert	90
140. Methods of testing skin irritants: Lynch	96
141. The "Drum" penetration test for fabrics: Lynch	99
142. Skin irritant tests: Lynch	100
143. Penetration tests on Fabric E.S.S. 15 with G-34: Lynch	104
144. Penetration test on Fabric #29: Lynch	105
145. Report on Ricin: Beaver & Smith	106
146. Summary of report of Pharmacological Division, May 1, 1918	110
147. Arsenious Bromide, toxicity on mice: Kuhn & Todd	112
148. Pyrosulfuryl Chloride, toxicity on mice: Kuhn & Todd	113
149. O-Methyl M-Isopropylphenyl Isonitrile, toxicity on mice: Kuhn	114
150. Report on toxic concentration of Mustard Gas for various lengths of exposure: Kuhn	115

PR 4: Reports 151-200, E.K. Marshall

151. Toxicity of Bromcyanogen on mice: Kuhn (4/18/1918)	1
152. Report on mice exposed to Chloropicrin for various lengths of time: Kuhn (4/15/1918)	3
153. Toxicity of Hydrocyanic Acid on dogs: Miller (4/18/1918)	6
154. Toxicity of G-178 on dogs: Miller and Gross (4/18/1918) (7½	

min. exposure)	8
155. Toxicity of G-178 on dogs (10 min. exposure): Miller and Gross (4/18/1918)	9
156. Toxicity of G-178 on dogs (15 min. exposure): Miller and Gross (4/18/1918)	10
157. Toxicity of G-178 on dogs (1 hr. exposure): Miller and Gross (4/18/1918)	11
158. Toxicity of G-178 on dogs (2 hr. exposure): Miller and Gross (4/18/1918)	12
159. Toxicity of G-178 on dogs (4 hr. exposure): Miller and Gross (4/18/1918)	13
160. Toxicity of Butyl Mercaptan on dogs: Miller and Hopkins (4/18/1918)	14
161. Toxicity of G-178 on monkeys: Miller and Gross (4/18/1918)	15
162. Report on Chloracetophenone: Sherwood, Snyder and Gavin (4/4/1918)	16
163. Physiological tests on man with G-67: Sherwood and Snyder (4/5/1918)	19
164. Physiological tests on man with Benzyl Bromide: Sherwood and Snyder (4/8/1918)	21
165. Physiological tests with Superpalite: Sherwood and Snyder (4/11/1918)	22
166. Physiological tests with Bromoacetone: Sherwood, Snyder and Gavin (4/19/1918)	23
167. Physiological tests with Chloroacetone: Sherwood, Snyder and Gavin (4/19/1918)	25
168. Physiological tests with Martonite: Sherwood and Gavin (4/19/1918)	27
169. Skin irritant tests with Mustard 1: Smith (4/5/1918)	28
170. Skin irritant tests with Mustard 2: Smith (4/5/1918)	29
171. Skin irritant tests with Mustard 2 (Brown crystals): Smith (4/5/1918)	30
172. Skin irritant tests with G-34 and 15% CHCl ₃ : Smith (4/15/1918)	31
173. Skin irritant tests with Tribromomonochloroacetone: Lynch and Smith (4/17/1918)	32
174. Skin irritant tests with Phenyldichloroarsine: Lynch and Smith (4/17/1918)	34
175. Skin irritant tests with AsF ₃ : Smith (4/30/1918)	36
176. Skin irritant tests with G-34 (Crude): Marshall (5/1/1918)	38
177. Skin irritant tests with G-34 (Pure): Marshall (5/1/1918)	39
178. Skin irritant tests with G-34 (Crude with SB Salts): Lynch and Smith (4/29/1918)	40
179. Skin irritant tests with Methyldichloroarsine: Lynch and Smith (4/30/1918)	41
180. Skin irritant tests with Diphenyliodoarsine: Lynch and Smith (4/30/1918)	42
181. Skin irritant tests with Diphenylchloroarsine: Lynch and Smith (4/15/1918)	43
182. Skin irritant tests with Anisyldichloroarsine: Lynch and Smith	44
183. Emulsifying agents for G-34: Lynch and Smith (4/16/1918)	45
184. Removal of G-34 from the skin: Lynch and Smith (4/15/1918)	46
185. Effect of moisture upon the irritant action of Mustard Gas: Lynch (4/12/1918)	49
186. Penetration of Fabric "Tower #159" by G-34: Lynch and Smith	

(4/17/1918)	53
187. Penetration of Fabric "Dupont E.S. 541" by G-34: Lynch and Smith (4/17/1918)	54
188. Penetration of Fabric "12033" by G-34: Lynch and Smith (4/29/1918)	55
189. Penetration of Fabric X ₂ by G-34: Lynch and Smith (4/29/1918)	56
190. Penetration of Fabric "Tower A" by G-34: Lynch and Smith (4/30/1918)	57
191. Penetration of Fabric "Nairn O D #1" by G-34: Lynch and Smith (4/30/1918)	58
192. Penetration of Fabric "Tower W.S.O.D." by G-34: Lynch and Smith (4/30/1918)	59
193. Report on analysis in dog box of G-67: Miller and Satler (4/16/1918)	60
194. Toxicity of Diphenylbromoarsine on mice: Kuhn (5/1/1918)	62
195. Toxicity of Symmetrical Dichloroacetone on mice: Kuhn (5/1/1918)	63
196. Toxicity of Trichloroacetone on mice: Kuhn (5/1/1918)	64
197. Toxicity of Tribromomonochloroacetone on mice: Kuhn (5/1/1918)	65
198. The toxicity and lachrymatory power of certain Chloroacetones: Marshall (6/20/1918)	66
199. Report on dogs exposed to Parazol and Sodium Cyanide at Naval Proving Ground April 23, 1918: Kuhn	67
200. Toxicity of Nickel Carbonyl on mice: Kuhn (5/11/1918)	70

PR 5: Reports 201-250, E.K. Marshall

201. Monochloroacetone, toxicity on mice: Kuhn	1
202. Tribromomonochloroacetone, toxicity on dogs: Gilbert	2
203. Chloroacetyl fluoride, skin irritant, tests on dogs: Smith	4
204. G-178, toxicity on dogs	5
205. Determination of smallest concentration detected by eyes, nose, throat, or lower respiratory tract: Sherwood & Gavin	6
206. G-76, Physiological tests on man: Sherwood, Snyder and Gavin	7
207. Acetyl Fluoride, toxicity on mice: Kuhn	9
208. Concentration of CO ₂ in sealed dog box: Wible & Jones	10
209. Asymmetrical Dichloroacetone, determination of smallest concentration detected by eyes, nose, throat, or lower respiratory tract	11
210. Chemical methods up to May, 1918, used in laboratory of the Pharmacological Division for estimation of low concentration of toxic compounds in air mixtures: Satler	12
211. Symmetrical Dichloroacetone, determination of smallest concentration detected by eyes, nose, throat, or lower respiratory tract: Sherwood and Snyder	22
212. "Sneeze Blue", determination of smallest concentration that can be detected by eyes, nose, throat, or lower respiratory tract: Sherwood	23
213. Irritating effects of Hydrocyanic Acid, Chlorcyanogen, and Bromcyanogen noted in bomb pit: Kuhn	27
214. Sulfur, toxicity and irritant effects on dogs: Gilbert	28
215. Methyl dichloroarsine, toxicity on dogs, 30 min. exposure: Miller & Gross	30

216. Methyl dichloroarsine, toxicity on dogs, 7½ min. exposure: Miller & Gross	31
217. Symmetrical Dichloroacetone, toxicity on dogs: Gilbert	32
218. Thiophosgene, toxicity on mice: Kuhn	34
219. Asymmetrical Dichloroacetone, toxicity on mice: Kuhn	35
220. Effects of dilute concentrations of various gases on man	36
221. Dogs exposed to Hydrocyanic Acid at Naval Proving Grounds, Indian Head, MD: Kuhn	38
222. Toxicity of Cyanogen Chloride for the dog, rabbit, guinea pig, rat, and mouse on inhalation: Marshall & Miller	39
223. Dogs exposed to Mustard Gas in the field: Kuhn	46
224. Dogs exposed to Sodium Cyanide at Naval Proving Grounds, Indian Head, MD: Kuhn	47
225. Toxicity of Arsine on fogs: Marshall & Miller	48
226. Determination of Diphenylchloroarsine in air mixtures by modified Gutzeit method: Sharp	50
227. Dogs exposed to Bromoacetone at Naval Proving Grounds, Indian Head, MD: Kuhn	53
228. Method of determining persistence of lachrymators: Kuhn & Barba	54
229. Dogs exposed to a mixture of Sodium Cyanide and Parazol at Naval Proving Grounds, Indian Head, MD	55
230. Method of analysis of low concentration of Diphenylchloroarsine in air mixtures: Satler	56
231. Acetyl Fluoride, skin irritation (on dogs): Smith	60
232. Dogs exposed to Bromxylol at Naval Proving Grounds, Indian Head, MD: Kuhn	61
233. Toxicity of Superpalite on dogs: Marshall & Miller	62
234. Toxicity on dogs (scale)	64
235. Toxicity scale on mice	65
236. Trichloroacetone, determination of smallest concentration that can be detected by eyes, nose, throat, or lower respiratory tract: Sherwood & Snyder	69
237. Effect of G-34 on skin of horse: Smith	70
238. Effect of lachrymators on horse: Smith	71
239. Arsenic Trifluoride, toxicity on guinea pigs: Miller & Gross	73
240. Diphenylchloroarsine, toxicity on dogs: Gilbert	74
241. Lewisite, toxicity on dogs: Gilbert	76
242. Closed chamber method for testing toxicity: Gilbert	78
243. Toxicity of Cyanogen Bromide for the dog, rabbit, guinea pig, rat, and mouse, on inhalation: Marshall & Miller	83
244. Comparison of the toxicity and action of G-178 and G-67 on inhalation: Marshall	93
245. Arsenic Trifluoride, toxicity on dogs: Miller & Gross	95
246. Chloroacetyl fluoride, toxicity on dogs: Miller & Gross	96
247. Lewisite, skin irritation, on dog, monkey, and man: Smith	97
248. Toxicity of Lewisite on dogs: Smith	99
249. Lachrymation of horse by G-40: Smith	101
250. G-76, toxicity on dogs, rats, and guinea pigs: Miller & Gross	102

PR 6: Reports 251-300, E.K. Marshall

251. Lachrymators – Methods: Smith	1
252. Summary of work to May 10 th , 1918 in the Pharmacological	

Division: Marshall	4
253. Removal of Mustard Gas from the skin: Marshall	6
254. Skin irritant effects of G-34 on rabbits: Smith	7
255. Experiments on absorption and excretion (using phenol-sulfonphthalein): Kolls and Smith	8A
256. Penetration of fabrics by G-34: Smith	10
257. Method of detecting Dihydroxyethyl sulfide in urine: Marshall	11
258. The absorption of Mustard Gas through the lungs: Marshall	12
259. Method of detecting Dihydroxyethyl sulfide in dog's urine: Beaver	13
260. Report on urine analysis of dogs gassed with G-34: Smith	15
261. Remedies for Mustard Gas burns: Lynch	17
262. Toxicity of G-67 on dogs (2½ min. exposure): Miller	18
263. Report of respiratory rate of dogs, rabbits, rats, canaries and mice: Kuhn	19
264. Preliminary report on toxicity of Mustard Gas for various species and different times of exposure: Marshall	22
265. Progress of work in Pharmacological Research Division for May, 1918: Marshall	24
266. Physiological effects of Mustard Gas and its absorption through the lungs and skin: Lynch	25
267. Experiments with Tiger Slugs as a detector of toxic gases: Miller	32
268. Preliminary report on protection of skin against vapor burns (Mustard): Marshall	37
269. Report for June 15 th , 1918 – was made up of reports 266, 267, 264 and 259.	38
270. Aeration method for determining the smallest concentration of a gas that can be detected by man and minimal lachrymatory con- centration: Sherwood	39
271. Description of apparatus and method used in determining the toxicity of gases on dogs: Marshall	41
272. Apparatus and method for determining toxicity on mice: Marshall	43
273. Report on continuous flow gassing chamber: Marshall	46
274. Protection of the skin against vapors of Mustard Gas by soap: Marshall	49
275. The treatment of skin which has been exposed to Mustard Gas.	50
276. Preliminary report on Kerosene treatment of Mustard 1 burns: Von Hess	52
277. Toxicity on dogs of Mustard 1: Miller & Hopkins	54
278. Toxicity tests on dogs at different lengths of exposure with Arsine: Miller & Hopkins	55A
279. Penetration of rubber boot by G-34: Smith	58
280. Superficial aspects of the action of Mustard Gas on the skin of monkey, cat, goat, guinea pig, horse, rabbit and dog: Smith	59
281. A standard vapor test for skin irritants: Lynch	63
282. Removal of Mustard Gas from the skin – Report II: Lynch	65
283. Protection of the skin against Mustard Gas vapors: Lynch and Von Hess	67
284. Report on regassing with Superpalite: Miller	70
285. A new method for the study of skin irritants: Lynch, Williams and Barba	72
286. The absorption and penetration of Mustard Gas through the horse's hoof: Lynch	74
287. Minimum burning concentration of Mustard Gas in oils: Smith	75

288. Individual variation in susceptibility to Mustard Gas (Method) <u>#1:</u> Lynch	77
289. Toxicity of Mustard Gas for various species: Marshall	79
290. Individual variation in susceptibility to Mustard Gas (military importance) <u>II:</u> Marshall, Lynch and Smith	81
291. Penetration of fabrics by G-34: Williams	91
292. Symptomatology of Mustard Gas poisoning in dogs by inhalation: Marshall, Von Hess and Miller	92
293. Removal of Mustard Gas from the skin: Von Hess	97
294. Treatment of Mustard Gas burns with Amines: Marshall and Smith	104
295. Effect of excision of skin on Mustard Gas burns: Von Hess	106
296. Toxicity of Mustard Gas for different species: Marshall	107
297. Protection of the skin against Mustard Gas vapor burns (ointment report): Lynch & Williams	108
298. Preliminary report on the relation between lethal concentration and time of exposure for dogs exposed to toxic gases: Marshall	113
299. Use of Benzyl Alcohol for the relief of itching in Mustard Gas burns: Von Hess	116
300. (Report #300 (Report on field test with G-34) was not considered as official, therefore was not copied for this volume)	

PR 7: Reports 301-336, E.K. Marshall

301. Prevention and Treatment of Mustard Gas Burns on the Skin by Flaxa Liquid Soap: Von Hess and Williams	1
302. Report on Tests of Sensitivity to Mustard Gas conducted at Edgewood Arsenal 8/28/1918: Marshall Jr., Von Ness, Smith, Barba and Williams	1b
303. Further Observations on Sensitivity of Individuals to Mustard Gas: Marshall, Smith and Williams	3
304. The Protection afforded against Mustard Gas Vapor by Ointments (Experiments with low concentration for a long exposure): Marshall, Smith and Williams	13
305. Penetration of Rubber Samples 2C-8C inclusive by Liquid G-34: Smith	19
306. Use of the Benzyl Alcohol for the Relief of Itching in Mustard Gas Burns: Von Hess	21
307. Protection against the Vapors of Mustard Gas by Fabric “Simplexene B”: Smith & Williams	22
308. Sensitivity of Eyes of Animals to Mustard Gas: Hess and Barba	26
309. Mustard Gas Effects on the Cornea: Hess and Barba	27A
310. Report on Field Experiments with Mustard Gas: Marshall, Miller and Williams	32
311. Report on Sulfonated Corn Oil	48
312. Toxicity of “D.P. Fabric” and Tetrabromoketodihydrobenzol: Smith	50
313. Symptomatology of Mustard Gas Poisoning in Goats by Inhalation: Von Hess	51A
314. Symptomatology of Mustard Gas Poisoning in Monkeys as compared with Dogs: Von Hess	55
315. Solubility and Hydrolysis of Mustard Gas in Water: Hopkins	58
316. The Toxicity of Mustard Gas for Different Species: Marshall,	

Miller, Reed and Beaver	67
317. Report on the Treatment of Mustard Gas Burns with "The Henry Mixture": Smith	107
318. The Minimum Concentration of Mustard Gas effective for Man: Reed	109
319. Effect of Potassium Permanganate on Mustard Gas Burns: Smith and Williams	116
320. Individual Variation in Susceptibility to Mustard Gas: Marshall, Smith and Williams	118
321. Treatment of Mustard Gas Burns on Dogs with Picrid Acid: Smith	120
322. Mustard Gas Effects on the Eye – Minimal Corneal Ulcer Concentrations: Von Hess and Barba	122
323. Mustard Gas Effects on the Eye – Minimal Conjunctivitis Concentrations: Marshall, Von Hess and Barba	126
324. Mustard Gas Effects on the Eye – Regassing and Corneal Sensitivity: Von Hess and Barba	127
325. Estimation of Small Amounts of Mustard Gas by means of the Hydrogen Ion Concentration Method: Hopkins	131
326. Penetration of a number of Protective Fabrics by Mustard Gas: Williams and Smith	139
327. Mustard Gas Effects on the Eye – Treatment of Corneal Ulceration: Von Hess and Barba	144
328. The Sensitivity of Animals to Mustard Gas: Marshall and Williams	148
329. The minimum concentration of Mustard Gas effective for Man: Reed, Hopkins and Weyand	150
330. Treatment of Mustard Gas Burns with Radioactive Calcium: Smith	156
331. Chronic Poisoning of Man by continued exposure to Cyanogen Chloride: Reed and Marshall	158
332. Ethyldichloroarsine: Von Hess and Euwer	162
333. Minimum concentrations of Hydrocyanic Acid necessary to kill Dogs on Four to Seven Hour Exposures: Miller and Gross	167
334. Minimum lethal concentration of Phosgene for Dogs, Monkeys, Mice, Rats, Rabbits and Guinea Pigs: Miller and Gross	170
335. Toxicity Report on Mustard Gas: Miller and Gross	176
336. History and Summary of Work of the Pharmacological Research Section	180

CHEMICAL DEVELOPMENTS SECTION (CD) :

CD 1: Reports 1-33

1. Horse Mask Impregnated with Komplexene: R.G. Knowland	2
2. Impregnation of the Horse Mask with Komplexene: R.G. Knowland	19
3. Source of Chemicals for Horse Mask Impregnation: Holton	27
4. Breath Shield for Horse Mask: R.G. Knowland	31
5. Test on Horse Mask Fabrics which were submitted by Lieut. Watson, June 3, 1918: T.M. Knowland	33
6. Horse Mask Aging Tests: R.G. Knowland	38
7. Military Tests on Horse Masks: R.G. Knowland	43

8. A New Horse Mask for G-34, G-28, and G-52: R.G. Knowland, T.M. Knowland, and W.N. Watson	46
9. Effect of Moisture on Buckles Used on Horse Masks: T.M. Knowland	70
10. Production and Use of the Simplexene G-34 Fighting Suit: T.M. Knowland	73
11. Source of Porous Iron Ore for Hydrogen Process: Holton	80
12. Absorption of New Gases by Charcoal and Soda Lime: R.G. Knowland	87
13. Penetration of Fabrics by Mustard I: A.C. Walker	92
14. Absorption Tests of Mustard I and Mustard I Composite: Weber	96
15. Chemical Detection of G-34. A Method Applicable to Testing Fabrics: Bridgewater	101
16. Protective Gauntlets: Abraham	103
17. Samples for Clothing to Protect against G-34: Abraham	106
18. Materials for Gloves and Clothing to Protect against G-34: Abraham	110
19. The Fighting Suit for G-34: R.G. Knowland & T.M. Knowland	113
20. Filter for Mandilini's Oxometer: Knowland and Bridgewater	122
21. General Report on Felts for Smoke Filters: Dickson	129
22. Effect of Various Felting Processes on Smoke Stoppage, Resistance and Clogging: Abrams and Spofford	143
23. Methods of Testing Efficiency of Filters against Sulfuric Acid Smoke: Abrams and Spofford	152
24. Flow of Air through Felt Filters: Abrams & Miller	158
25. Memorandum on the Status of the Smoke Felt Filter: Abrams	162
25a. Man Tests on Smoke Filters in 9-76. See Loose Files.	
26. Tests on Paper against G-76 made at the Bureau of Standards: Boynton	165
27. Investigation of Those Factors which control the Penetrating Power of F-10 Smoke: Clark, Pauli, Cyr, Stevenson, Walker, & Shriver	172
28. Effect of Moisture Content of a Felt upon its penetration by F-10 Smoke: Pauli and Shriver	179
29. Progress Report of the Felt Smoke Filter: Spofford, Miller, & Davis	181
30. Indicator Paper Method for Estimating the Penetration of a Filter by the Standard F-10 Smoke: Stevenson & Clark	188
30a. Indicator Method etc., by the Standard F-10 Smoke. See Loose Files	
31. Method of calculating the "Average" Pore Size of Smoke Filters: Dickson	192
32. Present Status of Flange Tests on Smoke Filters Preliminary to Standardization: Dickson	197
33. Investigation of the Pressing of Felts: Walker	218

CD 2: Reports 34-46, Part I, W.K. Lewis

34. A Proposed Method for Pulp Filter Investigation: Stevenson	1
35. Investigation of SA Smoke, and Filters to Protect against SA Smoke: Abrams and Spofford	4
36. Report on Papers for Smoke Filtering Purposes: Davis	17
37. Experimental Method Adopted for Developing the A.D.L.	

“Sucked-on” Filter (First Report on the Subject):	23
38. Investigation of Raw Cotton Seed Hull Fiber for the A.D.L. Filter (Report #2 on the subject): Stevenson, Cyr, and Stevens	28
39. Investigation of Raw Cotton Seed Hull Fiber for the A.D.L. Filter (Report #3 on the subject): Stevens and Pauli	34
40. Investigation of Cooked Cotton Seed Hull Fiber for the A.D.L. Filter (Report #4 on the subject): Stevens and Pauli	37
41. Conditions Governing the Formation of the A.D.L. Filter (Report #5 on the subject): Stevenson and Weber	39
42. The Protection of Troops in the Field against Mustard Gas: R.G. Knowland	46
43. A Study of the Conditions Necessitating the Use of a Mask as Protection against Poisonous Gases, and the Method Pursued in Issuing the Mask for this Purpose: R.G. Knowland and H.S. Wilkins	51
44. Capillary Flowmeters: Millard	67
45. Capillary Flowmeters: Dickson	71
46. A New Horse Mask for G-28, G-34 and G-53: R.G. Knowland, T.M. Knowland, and W.N. Watson	82

CD 2: Reports 47-48, Part II

47. Joint Report of the Chemical Development Section and the Mechanical Development Section on the “Sucked-on” Filter:	105
48. Method of calculating the “Average” Pore Size of Smoke Filters: Dickson	206

CD 3: Reports 49-58, Part I

49. Methods of Testing Charcoal by Means of Absorption of G-25	2
50. G-34 Tests on Various Absorbents: R.G. Knowland	12
51. Production of Hoof Packing Resistant to G-34: T.M. Knowland	14
52. Methods of Testing Gas Mask Absorbents: R.G. Knowland	17
53. Benzol, Toluol, & Xylol in Gas Tar Intermediates: Bridgewater	38
54. Commercial Production of Batchite: Wilkins	45
55. Development and Production of Batchite at the Plant of the Springfield Gas Co.: Wilkins	52
56. Toxic Smoke, Investigation of the Toxicity of a Mixture of H_2SO_4 Smoke with G-7: Stevenson & Reiman	116
57. Progress Report on SiF_4 Smoke: Stevenson	125
58. Comparative Field Tests on Standard Masks of the Effect of Resistance and of Dead Air Space: Dickson & Weber	129

CD 3: Reports 59-70, Part II

59. Distribution of Chlorine Concentrations in Special Canisters Gassed with G-52: Dickson, Bridgewater, and Boynton	141
60. Importance of Dead Air Space and Breathing Resistance as Affecting the Efficiency and Endurance of Men: Thorp	192
61. Gauntlets for Protection against G-34: Abraham	214
62. Permeability of Soap Powder Boxes to G-34: R.G. Knowland	219

63. Suggestions for Field Tests on Gas Masks: Dickson	221
64. Development of Super Glass Lenses at the Plant of the Super Glass Company, Wissinoming, PA: Weber	227
65. Memorandum on Analysis of Adhesive Plaster for Patching Masks: Weber	238
66. Commercial Production of HC: Abrams, Wilkins & Bridgewater	241
67. Camouflaging of Bleaching Powder: Stevenson, Clark & Abrams	255
68. Method for Determination of the Block Density of Charcoal: Brandt & Pattillo	266
69. Air Separation of Charcoal: Carr, Pattillo	269
70. Principles of Air-Density Separation and their application to Batchite: Freed, Pattillo, Carr, and Reinburg	273

CD: The Industrial Gas Mask, Knowland and Wilkins, December 1, 1918

CHEMICAL PRODUCTION SECTION (CP) :

CP 1: Reports 1-19, W.S. Rowland

1. Manufacture of Chloropicrin: Sutherland	2
Prussic Acid Situation: McPherson	6
Manufacture of Various Chlorides: McPherson	7
Manufacture of Phosgene: McPherson	8
2. Report of Section in Charge of Preparation of Gases on a Semi- Industrial Scale, Sept. 1-15, 1917: McPherson	10
Arsenic Trichloride: Sutherland	11
Stannic Chloride: Sutherland	13
Titanium Tetrachloride: Sutherland	17
Silicon Tetrachloride: Sutherland	18
Bromoacetone: Sutherland	19
Phosgene: Sutherland	20
Manufacture of Phosgene: Bradley	23
Manufacture of Hydrocyanic Acid: Bradley	24
Oxides of Nitrogen: Sutherland	26
Gas Cylinders and Valves: Sutherland	27
3. Report on Progress: McPherson (Oct. 1-15, 1917)	30
4. Report on Progress: McPherson (Oct. 15 – Nov. 30, 1917)	33
French Masks: Sutherland	34
Report on Progress: McPherson (Nov. 1-15, 1917)	36
5. November Progress Report: McPherson	38
6. Development of Manufacturing Division: McPherson & Rowland	40
7. Progress Report to Feb. 1, 1918: Rowland	45
8. Second Report on Bromine	47
9. Production of Ammonia Cyanide: Wesson	69
10. Preliminary Report in Manufacture of G-34: Wesson	71
Provisional Specification for Absorption Apparatus for the Manufacture of G-34: Wesson	75
11. Manufacturing Method and Apparatus Specification for G-337:	

	Hayden & Dubois	78
12.	Manufacture of Cyanogen Bromide: Smith & Dubois	131
13.	Manufacture of Adamsite: Fritschell & Dubois	139
14.	Manufacture of Magnesium Arsenide: Waddill and Dubois	146
15.	Manufacture of Strontium Chlorate: Coghlan, Schwartz & Dubois	151
16.	Manufacturing Method and Apparatus Specifications for Arsenic Trichloride: Smith, Schwarz, & Dubois	156
17.	Manufacture of Arsenic Trifluoride: Uhlinger, Schwarz & Dubois	163
18.	Manufacture of Arsenic Trichloride: Smith & Schwarz	168
19.	Manufacture of Anhydrous Hydrofluoric Acid: Watson, Schwarz, & Dubois	172

CP 2: Reports 20-39, W.S. Rowland

20.	The Manufacture of Diphenylchloroarsine: Hobbs and Schwartz	1
21.	The Manufacture of Diphenylchloroarsine, Supplement No. 1: Hobbs and Schwartz	15
22.	The Manufacturing Method, Apparatus, and Specifications for Nitrogen Tetroxide: Coghlin, Schwartz, and Dubois	16
23.	The Manufacture of Nitrogen Tetroxide, Supplementary Report: Coghlin and Schwartz	21
24.	The Distillation of Crude Mustard Gas in Iron: Smith and Schwartz	24
25.	Preparation of G-43 from NaCN and NaCN-Na ₂ CO ₃ Mixtures: Withrow, Spry, Beyer, Dorr and Witzemann	29
26.	Preparation of G-178 from G-43. I Influence of G-43 Concentration: Withrow and Witzemann	36
27.	Preparation of G-178 from G-43. II Preparation from Sodium Cyanide: Withrow	53
28.	Preparation of G-178 from G-43. III Witzemann's NaCN Procedure as a Manufacturing Basis: Withrow	64
29.	Preparation of G-178 from G-43. IV Influence of Initial G-178 on Chlorination Velocity: Witzemann and Withrow	66
30.	Preparation of G-178 from G-43. Small Scale Plant Absorption Tower Efficiency: Withrow and Witzemann	76
31.	Status of G-178 and G-43 upon Reversion from Mr. Dorsey to Mr. Rowland: Withrow	82
32.	Cyanide Raw Material for G-178 and other War Gas Manufacture: Withrow	89
33.	Preparation of G-178 by Zinc Reaction I: Withrow	100
34.	Preparation of G-178 by Zinc Reaction II. Chlorination with Discontinuous and Continuous NaCN Addition: Withrow	112
35.	Preparation of G-178 by Zinc Reaction III. Chlorination without Refrigeration: Withrow	121
36.	Preparation of G-178 by Zinc Reaction IV. Use as a Manufacturing Basis: Withrow	129
37.	Preparation of G-178 by Zn(CN) ₂ Method. Substitution of other Metals for Zinc: Withrow	133
38.	G-178. Influence of Chlorides of Na, Zn, and Fe upon Distillation Losses: Withrow	137
39.	Distillation and Polymerization of G-178: Withrow	143

CP 3: Reports 40-54, W.S. Rowland

40. G-178 Distillation as affected by HCl: Witzemann, McClure, & Withrow	1
41. G-178 Acidity Test with Litmus: Witzemann, Dorr, and Withrow	10
42. NaCN Losses by Water Hydrolysis: Withrow, Witzemann, and Dorr	13
43. G-178 Distillation in Presence of NH ₄ Cl and HCl: Withrow, Witzemann, & McClure	20
44. G-178 Preparation without Refrigeration: Withrow, Witzemann, & Adkins	26
45. G-178. Solubility and Detection of Water Therein: Withrow, Witzemann, Carey, & Dorr	38
46. Preparation of G-43 from Cyanized Briquettes and other Crude Cyanides: Withrow, Witzemann, Beyer, Dorr, and Spry	49
47. G-178 Storage in Steel: Withrow, Witzemann, & Carey	55
48. AsCl ₃ Plant Project of October, 1917: Smith and Withrow	79
49. Manufacture of Dichloromethylarsine: Uhlinger & Schwarz	83
50. Manufacture of Diphenylchloroarsine, Sodium Granulating System: Schwarz & Hobbs	91
51. Manufacture of Cyanogen Chloride: Withrow and Schwartz	94
52. Manufacture of Hydrocyanic Acid: Withrow and Schwarz	102
53. Refrigeration required in the Manufacture of Cyanogen Chloride: Pelton & Schwarz	106
54. Recovery of Sulfur from Mustard Gas Residues: Waddill, Streeter, & Schwarz	111

CP 4: Reports 55-68, W.S. Rowland

55. Manufacture of Butyl Mercaptan: Schulze, Basuin, & Schwarz	1
56. Purification of Phosgene: Pelton & Schwarz	9
57. Manufacture of Aluminum Chloride: Coghlan & Schwarz	12
58. Manufacture of Arsenic Trichloride, Supplement 2: Miller & Schwarz	16
59. Manufacture of Chloroacetophenone: Smith and Schwarz	17
60. Manufacture of Magnesium Arsenide: Waddill, Staats, and Schwarz	23
61. Manufacture of Arsine: Coolbaugh, Waddill, & Schwarz	26
62. Manufacture of Chloroacetyl Chloride: Smith, Harris, and Schwarz	32
63. Manufacture of D.M., Supplement #2, Utilization of By-Product Hydrogen Chloride: Fritschel and Schwarz	40
64. Manufacture of D.M., Supplement #3, Substitution of Water Washing for Organic Solvent Washing of D.M.: Fritschel and Schwarz	43
65. Manufacture of Chloroacetic Acid: Streeter & Schwarz	45
66. Cyanogen Chloride as a Manufacturing Project: Withrow	48
67. Cyanide Raw Material for Cyanogen Chloride and other War Gas Manufacture: Withrow	106
68. Production of D.M. using Diphenylamine – Arsenic Trioxide and Hydrochloric Acid: Cramer	134

CP 5: Reports 69 (pp. 1-128), W.S. Rowland

69. Cyanogen Chloride Investigations: Witzemann & Withrow	1
-----------------------------------------------------------	---

PHARMACOLOGICAL AND TOXICOLOGICAL SECTION (PT) :

PT 4: Reports A-201 – A-250, A.S. Loevenhart

201. Preliminary report on pigmentation of human skin following the application of various skin irritants: Hanzlik	1
202. Isothiocyanomethyl ether and Isothiocyanodimethyl ether; skin irritant tests on dogs: Huston and Hanzlik	3
203. Diphenylchloroarsine – skin irritant tests on dogs: Mulligan and Hanzlik	4
204. Determination of the lowest effective concentration of Mustard-1 on dog's skin: Dodge and Hanzlik	7
205. Effects of different concentrations of vapor of Mustard-1 on dog's skin: Tarr, Dodge and Hanzlik	13
206. Preliminary report on the comparative skin irritant properties of Mustard-1; Mustard-1, Composite 60%; Mustard-1, Composite 70%: Huston and Hanzlik	18
207. Effects of different concentrations of G-34 vapors on dog's skin: Tarr and Hanzlik	21
208. Benzenesulfocyanate – irritant tests on dog's skin: Huston and Hanzlik	24
209. Lead Tetraphenyl – skin irritant tests: Tarr	25
210. Effect of direct application of Mustard-1 on dog's skin compared with G-34 as control in the same and different animals: Dodge and Hanzlik	26
211. I-Isothiocyanomethyl I-Isothiocyanooethyl Ether – Toxicity on mice: Kuhn and Todd	45
212. Xylene Toluene – Toxicity on mice: Kuhn and Todd	46
213. Mixture of G-34 and G-313, aeration method – toxicity on dogs: Kruse and Dallwig	47
214. Mixture of G-34 and G-313, spray method – toxicity on dogs: Martin and Dallwig	54
215. G-178 (in 75 mm shells fired statically) toxicity on goats and dogs: Kolls and Kuhn	57
216. G-178 (fired statically in a Livens projectile) toxicity on goats and dogs: Kolls and Kuhn	58
217. G-178 (field test) – toxicity on goats and dogs: Kuhn and Kolls	60
218. G-52 – toxicity on dogs: Kuhn and Kolls	63
219. G-7 – toxicity on dogs: Kolls and Kuhn	67
220. 50% Admixture of G-31 and G-52 (cylinder) – toxicity on dogs: Kolls and Kuhn	71
221. Magnesium Arsenide – toxicity on dogs: Kolls and Kuhn	73
222. Anilite explosion products – toxicity on dogs and mice: Kuhn and Todd	74
223. Isothiocyanodimethyl Ether – man tests: Sherwood and Reardon	79
224. Preliminary chemical report on the use of Potassium Iodide and Potassium Iodate in solution as a reagent for Chlorine products: Satler and Bergeim	81
225. Effects of Chloroethylmethyl sulfide on dog's skin: Huston, Tarr	

and Hanzlik	92
226. Chloroacetophenone – skin irritant tests on dogs: Huston and Hanzlik	93
227. Effects of Dichlorodiyethyltellinodichloride on dog's skin: Huston, Tarr & Hanzlik	94
228. Effects of mixture of Methyl and Propyl Mustard on dog's skin as compared with G-34 as control: Huston, Tarr and Hanzlik	95
229. Normal Butyldichloroarsine – skin irritant tests on dogs: Huston and Hanzlik	97
230. Effects of Iodoacetophenone on dog's skin as compared with C-41 as control: Huston, Tarr and Hanzlik	99
231. Mixtures of G-34 and Carbon Tetrachloride and Chlorobenzol – skin irritant tests on dogs: Tarr	101
232. Effects produced by different concentrations of Mustard-1 vapor through fabrics: Dodge, Tarr and Hanzlik	103
233. Effects of Diphenylcyanoarsine on dog's skin as compared with G-34 and G-76: Huston and Hanzlik	106
234. Effects of different concentrations of G-349 vapor on dog's skin: Tarr and Hanzlik	108
235. Vapor effects of G-319 on skin of man: Huston and Hanzlik	111
236. Lowest effective concentrations of Mustard-1 and G-34 on skin of man and monkey: Dodge and Hanzlik	113
237. Comparative effects of Mustard-1 and G-34 as skin irritants: Hanzlik	118
238. Ethyl Ester of Fluorosulfonic Acid – skin irritant tests on dog and man: Tarr and Hanzlik	125
239. Chloromethyl 1,2-Dichloroethyl Ether – toxicity on mice: Todd and Cohn	126
240. Dichloroethyl Chlorosulfonate – toxicity on mice: Kolls and Ransom	127
241. Ethylseleno Cyanide – toxicity on mice: Kuhn and Cohn	128
242. Di-isothiocyanidimethylether – toxicity on mice: Todd and Cohn	129
243. Dithio Acetone – toxicity on mice: Todd and Taucher	130
244. B-Chloroethyl Chloroformate – Toxicity on mice: Todd, Cohn and Taucher	131
245. Nitrosomethylurethane – Toxicity on mice: Kuhn and Cohn	132
246. Ethylene Imine – toxicity on mice: Todd and Taucher	133
247. Ethyl Ester of Fluorosulfonic Acid – toxicity on mice: Todd and Cohn	134
248. G-332 – Toxicity on dogs: Ransom and Bogart	138
249. G-178 (field test) – toxicity on goats: Kuhn and Kolls	140
250. Butyl Mercaptan – man tests: Sherwood and Snyder	142

PT 5: Reports 251-300, A.S. Loevenhart

251. Di-Isothiocyanidimethyl Ether, man tests on: Sherwood & Reardon	1
252. Chloracetoxylone, man tests on: Sherwood and Reardon	3
253. Effect of various composites compared with Mustard-I and Mustard Gas on dog's skin: Huston, Mulligan, Connelly, Dodge, Tarr and Hanzlik	5
254. Comparison of Methylbromarsine, Mustard-1, Ethyldichloroarsine, Methyldichloroarsine and Phenyl dichloroarsine on dog's skin: Huston, Tarr and Hanzlik	19

255. Skin irritant effects of mixtures of Methyldichloroarsine and Mustard Gas compared with Mustard Gas and Methyldichloroarsine alone: Mulligan, Tarr and Hanzlik	26
256. Determination of the lowest effective concentrations of G-349 on dog's skin: Mulligan and Hanzlik	38
257. Effect of Mustard-2 on skin as compared with Mustard Gas: Connelly, Huston and Hanzlik	45
258. Effects of Mustard-1 on horse's skin using G-34 as control: Connelly, Tarr and Hanzlik	51
259. Direct effects of G-313 on human skin compared with G-34: Connelly and Hanzlik	56
260. Effects produced by direct application and vapor of G-319 on dog's skin: Huston, Tarr and Hanzlik	59
261. Skin irritant activity of G-313 in different solvents: Connelly and Hanzlik	62
262. Determination of the lowest effective concentration of G-313 on the skin of dogs: Connelly and Hanzlik	65
263. Lowest effective concentration of G-34 in solution on dog's skin: Dodge, Tarr and Hanzlik	70
264. Lowest effective concentrations of G-313 on skin of man: Connelly and Hanzlik	75
265. Effects of Mustard-1, G-319, G-349, G-313 and G-34 on monkey's skin: Connelly, Tarr and Hanzlik	80
266. Effects of Methylbromarsine on dog's skin: Huston and Hanzlik	84
267. Determination of the lowest effective concentration of G-349 in Absolute Alcohol on the skin of man: Mulligan and Hanzlik	87
268. Effects of different concentrations of G-313 vapor on dog's skin: Tarr and Hanzlik	92
269. Effects produced by Mustard-3 on dog's skin (directly & through fabrics): Huston, Tarr and Hanzlik	96
270. Effects of Trimethylarsenite on dog's skin: Mulligan and Hanzlik	99
271. Effects of Mustard-3 on skin compared with Mustard Gas as control: Huston and Hanzlik	101
272. Prophylactic treatment of skin lesions produced by C-41 on human skin: Huston, Tarr and Hanzlik	103
273. Effects produced by Mustard-1 through different fabrics on dogs skin: Dodge, Tarr and Hanzlik	106
274. Effects produced by Mustard-2 on dog's skin through fabrics: Huston, Tarr and Hanzlik	112
275. Skin irritant properties of Chloroacetophenone: Huston and Hanzlik	118
276. Effects of Xylenetoluene Nos. 1, 2, and 3 on dog's skin with G-34 as control: Huston, Tarr and Hanzlik	120
277. Effects of Dimethylarsinecyanide on dog's skin: Mulligan and Hanzlik	126
278. Toxicity of Phenylimidophosgene on dogs: Gavin, Stevenson and Merlis	129
279. Corneal Ulceration caused by Phenylimidophosgene: Ransom, Cohn and Merlis	133
280. Mercaptol (man tests with): Sherwood & Snyder	138
281. Dichloroethyl Sulfide – demustardization of clothing: Marlow	140
282. Effects of G-349 on dog's skin compared with G-34 as control: Mulligan, Tarr and Hanzlik	153
283. Effects of G-34 and Mustard-1 as compared with G-34 on skin of	

dog: Huston, Dodge and Hanzlik	164
284. Skin effects of mixtures of Mustard-1 and Mustard-2 on dogs as compared with Mustard-1 and Mustard-2 alone: Connelly and Hanzlik	171
285. Chemical reactions with Mustard-1 and G-34: Dodge and Hanzlik	179
286. Preliminary report on some extemporaneous measures for the protection of the skin against Mustard-1 by direct application: Dodge and Hanzlik	182
287. Para Bromo Chloroacetophenone – toxicity on mice: Cohn	184
288. Mustard Gas-Titanium Tetrachloride compound – toxicity on mice: Todd and Wagner	185
289. Ethyl Mercaptan – toxicity on mice: Ransom	187
290. Reaction product of Chlorine and Methyl Chloroformate – toxicity on mice: Todd and Taugher	188
291. Carbon Oxysulfide (sample #2) – toxicity on mice: Todd and Taugher	190
292. Carbon Oxysulfide (sample #1) – toxicity on mice: Todd and Taugher	191
293. Symmetrical Dichloroacetone – toxicity on mice: Todd and Taugher	192
294. Methyldibromoarsine – toxicity on dogs: Merlis	194
295. Disguising the odor of G-25 with Butyl Mercaptan: Sherwood and Snyder	196
296. Symmetrical Dichloroacetone – man test: Sherwood and Snyder	199
297. Dichloroacetophenone – man tests: Sherwood and Grose	201
298. Action of water on Diphenylchloroarsine: Bergeim	203
299. Hydrolysis of Mustard-1: Bergeim	204
300. Action of water on Alkyl Dichloroarsines: Bergeim	207

PT 7: Reports 331-350, A.S. Loevenhart

331. Report on skin irritant properties of G-34 Titanium Tetrachloride: Booth and Hanzlik	135
332. Report on analysis of Tetrachlorodinitroethane: Wible and Wahl	139
333. Report on comparative persistency of G-25 and G-34: Holder, Weiner and Block	146
334. Report on persistence tests on G-313: Holder and Weiner	151
335. Report on persistence tests on G-34: Holder, Weiner and Scholmowitz	163
336. Report on decomposition of Dichloroarsines: Wible, Reif and Leppard	179
337. Report on Dichloroethyl sulfide: Marlow	187
338. Report on persistence tests on Mustard 1: Holder and Weiner	199
339. A comparative study of the toxicity of some substitution products of Arsine: Gasser	223
340. Report on effects of different concentration of vapor of G-34 on human skin: Hanzlik and Killinger	238
341. Report on the effects produced by M-I Hydroxide on dog and human skin: Booth and Tarr	242
342. Report on irritant properties of the vapors of Methyldichloroarsine on the skin of man and dog and the protection afforded by olive drab woolen cloth: Tarr, Pullen and Hanzlik	245
343. Report on Brom D.M.: Sherwood and Groce	251

344. The reaction product between Chlorine and Methyl chloroformate: Sherwood and Snyder	253
345. Report on Ethyl Mercaptan: Sherwood and Snyder	255
346. Report on crude G-34 (85%): Russell and Dallwig	257
347. Report on mixture of G-34 (80%) Carbon Tetrachloride (20%): Russell and Dallwig	261
348. Report on mixture of G-34 (average 75%) G-52 (average 25%): Kruse and Dallwig	264
349. Report on mixture of G-34 (80%) G-25 (20%): Nimmo and Dallwig	268
350. Report on mixture of G-34 (80%) Chlorobenzol (20%): Russell and Dallwig	272

PT 8: Reports 351-402, A.S. Loevenhart

351. Summary report on admixtures of Carbon Tetrachloride, G-52, Chlorobenzol and G-25 with G-34: Gilbert, Kruse, Lyon, Martin, Nimmo, Russell, Searle & Dallwig	1
352. Mixture of G-34 and Carbon Bisulfide – Toxicity on dogs: Nimmo, Russell and Dallwig	4
353. Mixture of G-52 and G-178 – toxicity on dogs: Kruse and Dallwig	8
354. Mixture of G-7 and G-178 – toxicity on dogs: Nimmo and Dallwig	11
355. Mixture of G-7 and G-52 – toxicity on dogs: Kruse and Dallwig	14
356. Tetrachlorodinitroethane – toxicity on dogs: Kruse and Dallwig	17
357. Mixture of Tetrachlorodinitroethane and G-25 – toxicity on dogs: Kruse and Dallwig	20
358. Hydroxide of M-1 – toxicity on dogs: Nimmo and Dallwig	22
359. Adamsite – toxicity on mice: Gilbert	24
360. Chloroacetophenone oil – toxicity on mice: Taigher	26
361. Mercaptol – toxicity on mice: Taigher	28
362. Hexachlorodiethyl Sulfide (Chlorinated Mustard #1) toxicity on mice: Gilbert	30
363. Methyl Diethoxyarsine – toxicity on mice: Gilbert	32
364. Fluoromethyl Ether – toxicity on mice: Gilbert	33
365. Chloroacetodiphenyl – toxicity on mice: Gilbert	34
366. A-B-Octachlorodiethyl Sulfide (Chlorinated Mustard #2) – toxic- ity on mice: Gilbert	35
367. Ethylene Mercurous Chloride – toxicity on mice: Gilbert	36
368. Nitrotrichloroethylene – toxicity on mice: Gilbert	37
369. Dichloroacetophenone – toxicity on mice: Gilbert	38
370. Bromoacetonitrile – toxicity on mice: Gilbert and Todd	39
371. Ethyl Ester of Chlorsulfuric Acid – toxicity on mice: Gilbert and Todd	40
372. Dimethyl Trithiocarbonate – toxicity on mice: Gilbert and Todd	42
373. Monobromobutyrophenone – toxicity on mice: Gilbert and Todd	43
374. Methyldichloroarsine – toxicity on mice: Gilbert and Todd	44
375. Mercaptol – toxicity on mice: Gilbert and Todd	45
376. Para Chloro Chloracetanilide, Chloroacetotoluene – toxicity on mice: Gilbert	46
377. Dichlorodiethyl Tellino Dichloride – toxicity on mice: Gilbert	48
378. Toxicity on mice on the following compounds: (A) Ammonia Silicon Tetrachloride (B) Normal Butylarsine	

(C) Phenyl Chloroacetate	
(D) Xylene Toluene #2	
(E) Para Bromoacetophenone	
(F) Nitrobenzyl Bromide	
(G) Martonite	
(H) Brom D.M.	
(I) Triphenylarsine	
(J) Para Nitrobenzyl Cyanide:	
Gilbert	50
379. Toxicity on mice of the following compounds:	
(A) Phenyldichloroarsine	
(B) Methoxychloroacetophenone	
(C) Juglon	
(D) Chloroacetanilide	
(E) Iod D.M.	
(F) Diphenylphenoxyarsine	
(G) Nitrochloroacetanilide	
(H) p-Bromo Chloroacetophenone	
(I) Thio Cyan D.M.	
(J) Cyan D.M.	
(K) Basic Navy Blue D.A.	
(L) Mercury Trichloroethylene:	
Gilbert	53
380. M-1 – toxicity on dogs: Ransom & Bogart	56
381. Di-isothiocyanodimethyl Ether – toxicity on dogs: Merlis and Stevenson	58
382. G-337 – toxicity on dogs: Cohn & Ransom	61
383. Corneal Ulceration caused by a mixture of G-34 and CS ₂ : Ransom	63
384. Corneal Ulceration caused by crude G-34 on dogs: Ransom	67
385. Report on G-52 field test – toxicity on dogs: Kuhn	70
386. G-52 in Livens-fired statically – toxicity on goats and dogs: Kuhn	73
387. Mustard Gas and admixtures (toxicity on dogs): Kuhn and Kolls	76
388. G-52 fired statically in Livens – toxicity on dogs: Kuhn	99
389. G-52 absorbed in pumice stone fired statically in Livens – toxicity on dogs: Kuhn	102
390. Report on 50-50 mixture G-52 and G-25 in Livens fired statically (toxicity on dogs): Kuhn	104
391. G-25 fired statically in Livens – toxicity on dogs: Kuhn	107
392. G-25 in Livens fired statically – toxicity on dogs: Kuhn	110
393. G-52 absorbed in pumice stone, fired statically in Livens – toxicity on dogs: Kuhn	113
394. G-313 candles – toxicity on dogs: Kuhn	115
395. Comparison of crude G-34 and crude G-34 plus CS ₂ – toxicity on dogs: Kuhn	117
396. Comparison of G-313 and G-34 – toxicity on dogs: Kuhn	119
397. Magnesium Arsenide – toxicity on dogs: Kuhn	121
398. Comparative efficiency of Phosgene and Cyanogen Chloride and a mixture of the two in the field: Kolls and Satler	124
399. Sampling of G-76 in air mixtures: Lukasek	139
400. Toxicity of M-1 and composites: Gasser, Chance, Biser, Mack and Scardaccione	146
401. Physical experiments on M-1 vapor in sealed glass chambers: Gilbert and Johnson	163
402. Comparative persistency of G-337 and G-361: Holder, Lathrop and	

PT : Summary of Achievements 1917-1918

PT : Weekly Conferences

OFFENSE CHEMICAL RESEARCH SECTION (OR):

OR 1: Arsenic Derivatives, Part I, (Reports 1-62)

1. Ethyl Arsine: Lathrop	1
2. Preparation of compound Mg ₃ As ₂ : Rosenthal	4
3. Arsenic Trifluoride: Boehner	5
4. Arsenic Fluoride: Boehner	6
5. Synthesis of Diphenylchloroarsine (2 nd report): Cooperating Laboratories	7
6. Preparation of Arsenic derivatives: Dehn	9
7. Action of Benzene upon Arsenic Trichloride by the Friedel Crafts reaction: Giesy, Exp. Work	16
8. Action of Phenyl Magnesium Bromide upon Arsenic Trichloride. An attempt to prepare Phenylchloroarsines and Triphenylarsine by Grignard's reaction	18
9. Action of Metallic Sodium upon a mixture of Phenyl Bromide and Arsenic Trichloride. Preparation of Triphenylarsine by Fittig's Synthesis: Sebrell, Experimental Work	20
10. Preparation of Anisyldichloroarsine: Adams and Smith	23
11. Preparation of Arsenic Bromide for physiological tests: Adams and Murray	25
12. Preparation of Diphenylbromoarsine: Adams & Cyruli	26
13. Preparation of Diphenyliodoarsine: Adams	27
14. Preparation of Phenyl Magnesium Bromide: Adams	28
15. Third report on Diphenylchloroarsine, (Penn Clay). Resume of negative experiments: Wise & Francis	29
16. Preparation of Diphenylchloroarsine by Grignard reagent: Wise and Francis	33
17. Adamsite condensation of Arsenic Chloride and Diphenylamine: Adams & Worrall	34
18. Separation of Arsenic Chloride and Methyldichloroarsine: Adams and Blicke	38
19. Preliminary report on Methyldichloroarsine: Adams, Rapport, Murray & Henderson	40
20. Preparation of Triphenylarsine: Adams, Sachs and Hultman	48
21. Report on the preparation of Triphenylarsine by the Friedel-Craft's reaction: Griesy & Boord	50
22. Preparation of Triphenylarsine: Adams, Hultman & Sachs	56
23. Preparation of Diphenylchloroarsine and Phenylchloroarsine from Triphenylarsine and Arsenic Trichloride, Sealed Tube method	63
24. Manufacture of G-313: Adams, Murray, Blicke and Henderson	68
25. Preparation of Methyldichloroarsine: Adams, Murray and Blicke	77
26. Preliminary report on preparation of Arsine: Smyth, Clark, Coolbough, Forbes, Puckhaber & Vogt	83

27. Preparation of Methyldibromoarsine from Methyldichloroarsine: Adams & Blicke	88
28. Preparation of Ethyldichloroarsine: Adams & Murray	89
29. Attempted preparation of Arsenic Cyanide	90
30. Determination of Arsenic in organic compounds by the Pearce-Low method: Brinton	92
31. Preparation of Diphenylcyanoarsine: Adams & Hultman	94
32. The reaction between Sodium Thioarsenite and Dimethyl Sulfate: Adams	97
33. Preparation of Triphenylarsine, British method: Adams & Hultman	100
34. Preliminary report on Triphenylarsine Chloride: Scott	102
35. Decomposition of Triphenyldichloroarsine in moist air: Adams & Scott	104
36. Summary report on laboratory preparation of G-313: Adams	107
37. Report on the stability of mixtures of G-76 and Ammonium Nitrate, G-76 and TNT, G-76 and Amatol, Chloroacetophenone and Ammonium Nitrate, Chloroacetophenone and TNT, Chloroaceto- phenone and Amatol: Vibrans & Abbott	112
38. Decomposition of Triphenylarsine Dichloride on heating: Scott and Jennings	114
39. Data on Triphenylarsine and Diphenylchloroarsine: Hartshorn	117
40. Preparation of Arsanilic Acid, p-Aminophenyl-Arsenoxide, and p-Aminophenyl Dichloroarsine: Curran & Boord	118
41. Melting point of crude Diphenylchloroarsine: Hartshorn	121
42. Resume of the work on Phenylarsonic Acid: Geery & Boord	122
43. Experiments with crude D.M.: Adams & Worrall	128
44. Action of Acetylene on Phenyldichloroarsine in the presence of Aluminum Chloride as a catalyst: Adams and Hultman	129
45. Thiocyan D.M.: Adams and Holaday	131
46. Cyan D.M.: Adams & Holaday	132
47. Preparation of Diphenylphenoxyarsine: Adams & Babasinian	133
48. Use of fuming Sulfuric Acid (60%) on DA, DN, and Chloroaceto- phenone: Adams & Wood	134
49. Propellant Solvents for G-313: Wendt, Rosenthal and Wood	135
50. Preparation of Methylmethoxyarsine: Babasinian	138
51. Mixtures of D.A. and C.G. – the effect of impurities: Wendt, Rosenthal and Lebeson	139
52. Determination of DA by titration with Iodine in Acetic Acid solution: Brinton & Schrock	141
53. Preparation of Methyldiphenoxoarsine: Adams & Babasinian	150
54. Hydrolysis of Magnesium Arsenide by moist air: Overstreet & Banta	151
55. Solubility tests of various Arsenic compounds: Adams & Kamm	158
56. Solubility of Arsine in Hydrocyanic Acid, Arsenic Trifluoride and Butyl Arsine: Wendt, Rosenthal and Peterson	160
57. Final report on the preparation of liquid Arsine: Wendt, Coolbaugh, Vogt, Puckhaber	162
58. Attempt to prepare Magnesium Arsenide by the action of Arsenic on Magnesium Nitride: Wendt & Herz	166
59. Solutions of CG in G-7: Wendt, Rosenthal, Hurd & Peterson	168
60. Liquid G-7 as a solvent for toxic substances: Wendt, Rosenthal & Peterson	174
61. Vapor pressures of G-7 and CC: Rosenthal, Wendt & Hurd	178
62. Action of TiCl ₄ on DA: Wendt & Rosenthal	179

OR 1: Arsenic Derivatives, Part II, (Reports 63-87)

63. Control of the reaction between metallic Magnesium and metallic Arsenic: Wendt, Coolbaugh and Banta	180
64. Hydrate of Arsine: Wendt, Clark and Ford	182
65. Destruction of Magnesium Arsenide: Wendt, Hers and Middleton	186
66. Vapor pressure of solutions of G-7 with toxic substances: Wendt, Rosenthal, Ford, Lebeson and Peterson	190
67. Reactions of Arsine with organic compounds: Clark, Landt & Hurd	192
68. Preparation and special mixtures of MG, AL, ZN, FE, NA and mixed Arsenides: Rosenthal, Puckhaber and May	198
69. Densities of Mg_3As_2 and liquid AsH_3 and their relation to gas generated: Rosenthal	213
70. The preparation of Arsenides by reduction: Ray, Clark and Overstreet	217
71. Decomposition of Magnesium Arsenide by moist air: Ray and Rosenthal	226
72. Hydrolysis of Magnesium Arsenide with moist air: Rosenthal	242
73. Preparation of Arsenides by reduction: Ray, Clark & Overstreet	254
74. Liquefaction of Arsine: Ray, Peck, Rosenthal & Puckhaber	268
75. Purification of crude Cacodyl Chloride: Adams & Worrall	273
76. Preparation of Cacodyl Bromide: Adams & Worrall	274
77. Preliminary report on the stability of mixtures of G-76 and Ammonium nitrate, G-76 and TNT, G-76 and Amatol, Amatol and Chloroacetophenone: Vibrans & Abbott	275
78. Tests on Baker and Adamson samples of Coronone and Adamsite	278
79. A study of the preparation of Arsenides by reduction: Ray, Clark, and Overstreet	279
80. Preparation and Properties of Arsine: Overstreet (Inorganic Unit)	309
81. Absorption of Ethylene by Arsenic Trichloride in the presence of Aluminum Chloride: Organic Unit	337
82. Preparation and behavior of G-7: Fuller	341
83. Stability of Mustard I – Part II: Lewis & Perkins	344
84. Summary of reports on G-76 of “Sneeze Stuff”: Reyerson	349
85. Reaction of Toluene on Bromoacetone in the presence of Catalyst B: Lewis & Perkins	355
86. Solubility of L #1 and L #2: Lewis & Perkins	361
87. Preparation of Arsenic Bromide for physiological tests: Adams & Murray	362

OR 2: Chloroacetophenone, (Reports 90-137)

90. Bromoacetophenone: Helfrich and Reid	1
91. Chloroacetophenone: Helfrich and Reid	4
92. Progress report on Chloroacetophenone: Helfrich and Reid	6
93. Chloroacetophenone: Helfrich, Kimball and Reid	7
94. Chloroacetophenone: Helfrich, Kimball and Reid	10
95. Preliminary report on the preparation of Acetophenone, Chloroacetyl chloride, and Chloroacetophenone: Holm and Reid	12
96. Chloroacetophenone from Chloroacetyl Chloride and Benzene: Adams and Blicke	16

97. Acetophenone from Benzoic and Acetic Acids: Reid	17
98. A comparison of yields of Acetophenone given by Aluminum Chloride prepared by the Hydrochloric Acid and Chlorine method: Reid, Holm and Gregory	19
99. Chloroacetophenone: Helfrich, Kimball and Reid	21
100. Preparation of Acetophenone by the Friedel-Craft method: Holm, Kimball and Reid	25
101. Preparation of Chloroacetophenone: Reid, Holm and Kimball	32
102. Chloroacetophenone: Helfrich, Kimball and Reid	35
103. Preparation of Chloroacetyl Chloride from Chloroacetic Acid, Sulfur Chloride (Mono or Di) and Chlorine: Adams and Henderson	40
104. Preparation of Acetyl Chloride: Adams	42
105. Chloroacetophenone prepared from Chloroacetyl Chloride by Sulfur Chloride process: Gregory and Reid	44
106. Preparation of Chloroacetyl Chloride from Chloroacetic Acid and Phosgene: Adams and Heisig	45
107. Chloroacetophenone from Chloroacetyl Chloride obtained from Stewart and Co.: Gregory and Reid	50
108. The preparation of Acetophenone: Vibrans and Gruse	51
109. Preparation of Monochloroacetic Acid by direct chlorination of Acetic Acid: Adams and Engelbrecht	59
110. Chloroacetobiphenyl: Adams and Murray	63
111. Directions for the chlorination of Acetic Acid to Monochloroacetic Acid: Adams, Engelbrecht and Worrall	64
112. Preliminary report on the preparation of Chloroacetyl chlorine from 2B-Dichlorovinyl Ethyl Ether: Lewis, Perkins and Jones	67
113. Preparation of Chloroacetyl Chloride from Acetic Acid by hot-cold Chlorination: Lewis and Read	82
114. Method of removing Sulfur Chlorides from Chloroacetyl Chloride - preparation of pure Chloroacetyl Chloride: Vibrans, Grouse and Seitz	88
115. The use of fuming Sulfuric Acid (80%) on DA, DM and Chloroacetophenone: Adams and Wood	91
116. Purification of Chloroacetyl Chloride: Lewis, Jones and Read	92
117. Phenyl Vinyl Ketone and Chloropropiophenone: Vibrans, Gruse and Bump	107
118. The counter current chlorination of Acetic Acid: Adams and Engelbrecht	113
119. The preparation of Chloroacetothienone – problem 001-103: Babasinian	115
120. Chloroacetodiphenyl Oxide: Adams and Rappaport	116
121. Chloroacetodiphenyl Sulfide: Adams and Rappaport	117
122. Further report on the stability of mixtures of DA and TNT, Chloroacetophenone and TNT, Chloroacetophenone and Amatol: Vibrans and Abbott	119
123. Final report on Friedel and Craft's reaction between Diphenyl Ether and Chloroacetyl Chloride: Scott	121
124. Chloracids and Acid Chlorides	124
125. The preparation of anhydrous Aluminum Chloride: Wendt, Rosenthal and Banta	151
126. Report on the substitution of Ferric Chloride for a part of the Aluminum Chloride used in Friedel and Craft reaction: Sarver, Quigley and Reid	158

127. Chloroacetophenone from Chloroacetyl Chloride prepared by Dr. Boehner by chlorinating Acetyl-Chloride with Iodine: Gregory and Reid	160
128. Preparation of Aluminum Chloride from Bauxite and Phosgene: Coolbaugh	162
129. Preparation of anhydrous Aluminum Chloride from Bauxite: Wendt, Bittles, Puckhaber and Jones	166
130. Preliminary report on the preparation of Acetyl Chloride from Sulfuryl Chloride and Calcium Acetate: Lewis and Cassebeer	177
131. Report on oils obtained as by-products in the preparation of Chloroacetophenone: Reid and Frederick	183
132. Report on Dichloroacetophenone: Reid and Kimball	185
133. Report on Trichloroacetophenone: Kimball and Reid	189
134. Report on p-Bromophenacyl Chloride: Kimball and Reid	190
135. Report on p-Chlorophenacyl Chloride: Kimball and Reid	191
136. Report on p-Ethoxychloroacetophenone: Reid and Frederick	192
137. Report on Dichloroacetic Acid: Frederick and Reid	198

OR 3: Nitrogen Peroxide and Corrosion of Metals, (Reports 138-155)

138. Recommendations for Small Scale Plant Production of N ₂ O ₄ from As ₂ O ₃ and HNO ₃ : Ray	1
139. Properties and Preparation of Liquid Nitrogen Tetroxide: Ray, Clark, Overstreet & Rosenthal	4
140. Vapor Pressure of NO: Smyth and Rosenthal	19
141. Conversion of Arsenic Residue from the N ₂ O ₄ Progress into As ₂ O ₃ : Smyth, Rosenthal and Landt	21
142. Notes on the Manufacture of N ₂ O ₄ : Smyth & Rosenthal	26
143. Preparation and Properties of Liquid Nitrogen Peroxide: Ray, Clark, Overstreet and Rosenthal	29
144. Progress Report on the Corrosion of Metals: Hall	47
145. Action of Warfare Gases on Metallic Gun Parts Protected by Oxide Coatings: Ray and Banta	54
146. Corrosion of Valve Metals: Ray & Overstreet	59
147. Corrosion of Valve Metals: Ray & Overstreet	62
148. Report Concerning Exposure of Flutter Valves to Noxious Gases: Ray & Banta	66
149. Report Concerning Lowering of Freezing Point of Sulfuric Acids Containing Varying Amounts of SO ₃ by Addition of Other Substances and the Corrosive Effect of some of the Solutions upon Wrought and Cast Iron: Ray, Escott and Williamson	67
150. Corrosive Action upon Steel of Nitrogen Tetroxide and the Liquids used in its Preparation: Ray and Clark	79
151. Corrosion of Steel, Wrought Iron, and Cast Iron by certain Oleum Solutions: Ray and Williams	82
152. Corrosion Tests on Benedict Metal: Ray & Escott	88
153. Corrosion of Valve Metals – IV: Overstreet & Escott	91
154. Corrosion of Valve Metals – V: Overstreet & Escott	94
155. Report on Shell Corrosion Work: Lewis & Carpenter	96

OR 4: Fluorine, Part I, (Reports 156-167)

156. Attempts to Prepare Carbonyl Fluoride: Adams and Read	1
157. Action of Anhydrous Hydrofluoric Acid on Titanium Tetra-chloride and Related Compounds: Smyth and Banta	5
158. The Preparations and Properties of Boron Trifluoride: Clark and Banta	8
159. The Preparation of Fluorine: Wendt, Overstreet, Clark and Colbeth	17
160. The Reaction of Fluorine with a few General Types of Compounds: Clark, Clark and Colbeth	24
161. Researches upon Fluorine and its Compounds: G.L. Clark and A.H. Clark	29
162. The Preparation of Anhydrous Hydrofluoric Acid: Ray and Banta	55
163. A Summary Report on Preparation of Anhydrous H ₂ F ₂ : Smyth and Rosenthal	68
164. The Preparation of Anhydrous Hydrofluoric Acid: Smyth, Rosenthal, Ray and Banta	74
165. Briefs on AS ₂ O ₃ Recovery and on H ₂ F ₂ in G-34: Overstreet	96
166. Action of H ₂ F ₂ on Thiodiglycol and G-34: Smyth, Rosenthal and Ford	99
167. Preliminary Report concerning the Preparation of Fluorine by Chemical means: The Preparation and Properties of Bromine Trifluoride, and the Preparation of other Fluorides such as IF ₅ , COF ₂ , SF ₆ , CF ₄ , BF ₃ , etc. : Ray and Clark	104

OR 5: Cyanogen Chloride, Lachrymators, (Reports 192-256), Yale Laboratory

Cyanogen Chloride

192. The preparation of Cyanogen Chloride: Jennings and Scott	1
193. Method of preparing H-337: Conant	11
194. Preparation of G-178: Conant	12
195. Attempted preparation of G-178 from Potassium Ferrocyanide: Conant	14
196. Mixing of G-178 with G-52, G-67 with G-52, G-67 with G-34 and G-67 with G-25: Conant	16
197. Mixing of G-178 with other toxic substances: Conant	18
198. New method of preparing G-178 from solid Sodium Cyanide: Jennings	19
199. Second report on a method of preparing G-178 from G-184: Jennings	21
200. Jennings method of preparing Cyanogen Chloride: Conant, Vibrans and Sachs	23
201. Attempt to substitute Sodium Ferrocyanide for Sodium Cyanide in the Jennings' method of preparing G-178: Conant and Vibrans	26
202. Preparation of Cyanogen Chloride: Jennings	28
203. Bromobenzyl Cyanide: Adams and Murray	35
204. Solubility of Cyanuric Chloride: Adams and Vibrans	36
205. Polymerization of Chlorocyanogen: Adams and Vibrans	37
206. Purification of Chlorocyanogen: Adams	40
207. Preparation of G-178 by Jennings Method: Adams	41
208. Specific gravity of mixtures of Chlorocyanogen and Hydrocyanic Acid: Adams	42
209. Preparation of Bromxylyl Cyanide from crude Xylo: MacDonald	43

210. Investigation of yellow low boiling impurity in Cyanogen Chloride and the possibility of the presence of some explosive impurity: Jennings and Scott	45
211. Freezing points of Chlorocyanogen and Hydrocyanic Acid mixtures: Adams and Vibrans	47
212. Specific gravity determination of HCN from 70% to 100% by weight: Adams and Bly	48
213. Report on G-178: Bazuin	49
214. A test for moisture in G-178: Adams and Bly	60
215. The preparation and properties of Cyanogen Sulfide: Ray, Overstreet	61
216. Freezing points of Bromobenzyl Cyanide mixed with other substances: Adams and Worrall	64
217. Melting point for mixtures of G-337 and G-25: Hartshorn and Beebe	65
218. Progress report of the Organic Section: Conant	67
219. Solubility of Sodium cyanide and of Potassium cyanide in Hydrocyanic acid: Wendt and Rosenthal	69

Lachrymators

220. Report on Bromoacetone: Chambers	70
221. Report on Bromoacetone: Chambers, Lee	71
222. Report on the Martonite process: Brunel	81
223. Preliminary suggestions as to testing of Bromoacetone and Martonite for changes due to contact with containers: Brunel	88
224. Report on the process of manufacturing Martonite: Brunel	90
225. Report on Monochlorotribromoacetone: Brunel	125
226. Report on Martonite III: Brunel	126
227. Report on Tetrachloroacetone: Brunel	129
228. Report on Monochloroacetone: Brunel	130
229. Report on purification of Bromoacetone: Brunel	132
230. Report on Dichloroacetones: Brunel	133
231. Report #2 on Bromoacetone: Chambers, Lee and Anderson	137
232. Report on Martonite and Bromoacetone: Chambers	142
233. Report on the combined production of Xylyl Bromide and Martonite: Brunel	145
234. Report on Martonite: Brunel	149
235. Report on Martonite: Brunel	150
236. Report on the use of aqueous HBr for preparing Martonite: Brunel	155
237. Report on Chloroacetone (Continuation of report of the yield of Chloroacetone from Acetone: Brunel and Jefferies; analysis by M. Wilcox	169
238. Report on relative amounts of Dichloroacetone formed by chlorination of Monochloroacetone: Brunel and Jefferies	172
239. Stability of Xylyl Bromide and Bromoacetone in presence of metallic Lead: Kraus	176
240. Preparation of Xylyl Bromide: Boord	179
241. Action of Xylyl Bromide upon various metals: Boord	186
242. Preparation of Trichloromethyl Sulfochloride: Neher	188
243. Nitrobenzyl Chloride preparations: Adams and Maynard	191
244. Preparation of 2, 4-Dichlorobenzyl Bromide: Adams and Carlson	192
245. Preparation of p-Chlorobenzyl Bromide: Vibrans, Gruse and Fredriksen	194

246. Examination of unknown sample	196
------------------------------------	-----

Organic Preparations by Yale Laboratory

247. Preparation of Chloromethyl Chloroethyl Ether: Johnson	197
248. Preparation of Ethylidene Oxychloride: Johnson	200
249. Preparation of Isothiocyanodimethyl Ether: Johnson	203
250. Preparation of Isothiocyanomethyl Ethyl Ether: Johnson	206
251. The interaction of Potassium Thiocyanate with Dichloroethers: Johnson	209
252. p-Chloro-Chloroacetanilide: Johnson, Hill and Henze	216
253. Chloroacetanilide: Johnson, Hill and Kelsey	218
254. p-Bromo-Chloroacetanilide: Johnson, Hill & Kelsey	220
255. o-Chloro-Chloroacetanilide: Johnson, Hill & Kelsey	222
256. Preparation of Ethyl Selenocyanide: Johnson, Saxton and Deschavsky	225

OR 6: Miscellaneous Reports, Part II, (Reports 300-345)

300. Investigation of sample of irritant from freight car in Virginia: Adams and Strem	1
301. Substitute for Gasoline: Adams and Heisig	2
302. Johns Hopkins University field laboratories report of work completed up to July 14, 1918: Reid	6
303. Ohio State University field laboratory report of work completed up to July 14, 1918: Blood	13
304. Princeton University field laboratory report of work completed up to July 14, 1918: Neher	16
305. Purification of Trypan Blue: Vibrans	22
306. Separation of Isomers from crude Parazol: Adams and Henderson	24
307. Isoamylamine and Diisoamylamine: Adams and Kamm	25
308. Trimethyl Amine Hydrochloride: Adams and Blicke	26
309. Lead – Alkyls: Adams and Kamm	28
310. Report on Methylphosphine: Dolt	30
311. Purity of Parazol sample: Adams and Rapport	31
312. Hexanitrodiphenylamine: Adams and Matthews	32
313. Report on Nitrosomethylurethane: Brunel and Kneeland	34
314. Solubility of Chloroisonitrosoacetone in various solvents: Brunel and Jefferies	36
315. Nitration of Xylol: Adams and Rapport	38
316. Report on Diazomethane and related compounds: Brunel, Kneeland and Jefferies	43
317. Preparation of Bichlor-Mercuri-Ethane from Mercarbid: Wendt and Hurd	56
318. Report on the preparation of Mercury Trichloroethylene: Lewis and Jones	59
319. Preparation of Trichloromethyl Sulfur Chloride: Neher	61
320. Preparation of pure Nitrobenzene: Gruse	64
321. Preparation of various Bromophenyl Bromides: Adams and Strem	65
322. Preparation of Beta Naphthalene Sulfone Dichloroamine: Vibrans, Gruse and Soule	68
323. Report on Trichloroacetonitrile: Hale and Reid	70
324. Report on Bromidethyl Ether: Reid and Helferich	71

325. Johns Hopkins University Baltimore Maryland	73
326. Further report on the stability of mixtures of DA and TNT, Chloroacetophenone and TNT, Chloroacetophenone and Amatol: Vibrans and Abbott	74
327. Work completed in Organic Unit #5, at the Catholic University during the month of October	76
328. Report on work carried out at Columbia Unit	79
329. Phenylimidophosgene: Perkins, Shonle, Taylor and Lewis	89
330. Preliminary report on the preparation of 5-Oxy-1-4 Naphthaqui- none (Juglon): Ginter, Kerr and Lewis	104
331. Preliminary report on the preparation of Hydroflavlic acid: Ginter, Kerr and Lewis	112
332. A study of the action of Sulfur Monochloride upon Styrene and Stilbene: Jones, Gutekunst, Cassebeer, Levy, Curtis and Lewis	115
333. Report on man test of navy mask for Ammonia absorption: Finkelstein	128
334. "Tarastol" absorbent for Ammonia gas: Finkelstein	130
335. Progress report of Organic Research Unit No. 1: Beebe	132
336. Inorganic Unit: Overstreet	147
337. Report on oils for French masks: Patrick	160
338. Chlorinated Nitro explosives: Kerr, Lewis, Parker, Perkins and Ward	162
339. Report for the week ending April 13, 1918, of work at the Catholic University Annex: Lewis	169
340. Purification of Parazol prepared by Hooker Electrochemical Company: Adams	175
341. The removal of noxious gases by smoky flames: Beebe and Hetherington	177
342. Examination of a Gasoline substitute: Adams and Heisig	180
343. Preparation of Chlorinated Kerosene: Vibrans	182
344. A simple method for observing the penetration and hydrolysis of toxic gases in Protein and Lipoids: Hirschfelder	183
345. Report on certain quarternary Ammonium compounds derived from Trimethyl Amine: Reid (Johns Hopkins Detachment)	187

OR 7: Superpalite, Chloropicrin, Butyl Mercaptan and Acrolein, (Reports 346-390)

Superpalite

346. Production of G-49 at Princeton from Dec 1 – Dec 15, 1917: Neher	1
347. Possibility of obtaining G-49 from new sources: Neher	3
348. Progress of the work at Princeton on halogenated Ethers and Esters: Neher	6
349. Chlorination method for the preparation of G-49: Neher	9
350. Report on G-49: Conant	17
351. Report on purity of Superpalite furnished by W.S. Rowland: Adams	20
352. Preparation of Chloromethyl Chloroformic Acid Ester	21
353. Manufacture of Superpalite: Weisberg	24

Chloropicrin

354. Preparation of Chloropicrin: Hale and Reid	26
355. Colorimetric method for Chloropicrin: Wilkinson	28

356. Preliminary report on absorption of Chloropicrin by prepared charcoal: Reid and Helm	30
357. Absorption of G-25 from air: Conant	33
358. Influence of saline solutions on the yield of G-25: Wilkinson	35
359. Influence of the water used upon the yield of G-25: Lewis	37
360. Preparation of G-25 by New British Method: Conant	40
361. Solubility of Coronone in G-25 with a note on the stability of Rubber in the presence of the former compound: Hartshorn & Richardson	42
362. Melting point curves for mixtures of G-337 and G-25: Hartshorn & Beebe	44
363. Volatility of N.C.: Hartshorn & Mock	46
364. Application of Winkleman's Sodium Peroxide-Phenol-Disulfonic Acid method to the determination of Chloropicrin in the presence of Phosgene and free Chlorine: Brinton & Crockett	50
365. Method for the determination of Chloropicrin & Stannic chloride in air mixtures: Brinton & May	57
366. Preparation of Trichloronitroethylene	61
367. Effect of fuming Nitric acid upon Trichloroethylene: Jones, Parker and Ward	62
368. Effect of nitrating agents upon Tetrachloroethylene: Ward, Jones & Parker	67
369. Preparation of Tetranitromethane: Vibrans & Seitz	72

Phosgene

370. Thiophosgene: Helfrich & Reid	73
371. Attempts to determine Phosgene quantitatively as crystal violet: Helfrich & Reid	75
372. Thiophosgene: Adams & Carlson	78
373. Action of Phosgene on Ethylene Chlorohydrin: Adams & Billings	79
374. Preparation of pure Phosgene from commercial material: Wendt, Herz, Peterson & Armor	80
375. Purification of Phosgene: Smyth, Herz, Peterson & Armor	84
376. Removal of Chlorine from Phosgene (Final Report): Wendt, Herz & Armor	88

Butyl Mercaptan

377. Preliminary report on Butyl Mercaptan: Hale & Reid	93
378. Progress report on Butyl Mercaptan: Kramer, Holm, Frascati, Hale, Livingston & Reid	94
379. Butyl Mercaptan: Kramer, Holm & Reid	96
380. Butyl Mercaptan from Butyl Bromide: Boehner & Hahn	99
381. Preparation of Butyl bromide: Boehner & Hahn	100
382. Butyl Mercaptan: Kramer, Holm, Livingston & Reid	101
383. Preparation of Trichloroacetyl thiocyanate: Vibrans & Gruse	121
384. Preparation of Dimethyl trithiocarbonate: Vibrans & Gruse	123
385. Preliminary report on the removal of Alcohol from Butyl mercaptan: Reid	129
386. Some Dialkyl trithiocarbonates: Perkins, Taylor & Yon	131

Acrolein

387. Preliminary report on method of analysis of substance G-4: Mark	134
388. Acrolein, experimental part: Evans	137
389. Preparation of G-4 from Trimethylene Glycol: Engelder	145

390. Summary of experiments performed in the preparation of G-4 at
the University of Illinois: Engelder, Hultman, et al 148

OR 8: Mustard Gas, Part I, (Reports 391-432)

391. Report on 2, 2' Dichloroethyl sulfide: Hale	1
392. Attempts to prepare Dichloroethyl sulfide from Ethylene chloro-bromide: Helferich & Reid	2
393. Attempts to prepare Dichloroethyl sulfide from Ethylene chloro-iodide: Helferich & Reid	5
394. Report on G-34: Conant	9
395. Report on the chlorination of Methyl sulfide: Helferich & Reid	15
396. Report on the preparation of Glycol-Bromohydrin by the action of Ethylene on Hypobromous acid: Helferich and Reid	17
397. Progress report on the Organic Division: Conant	19
398. Progress report – Organic Division: Conant	22
399. Appendix to report on G-34: Conant	24
400. Progress report – Organic Division: Conant	26
401. Report on Sulfur dichloride and on treatment of Chlorides of Sulfur by Ethylene: Baskerville and Isaacs	28
402. Progress report – Organic Division: Conant	36
403. Preliminary report on the preparation of G-34 from Sulfur monochloride: Conant	38
404. Progress report on the preparation of G-34 from Sulfur dichloride: Conant	40
405. Progress report – Organic Section: Conant	48
406. Report on Kaolin: Kohler	51
407. Report on Kaolin: Kohler	53
408. Second progress report on the preparation of G-34 from Sulfur monochloride: Conant	54
409. Report on Dichloropropyl sulfide as prepared from Chlorohydrin from Commercial Research Company: Conant and Hartshorn	60
410. Report on the preparation of Dichloroethyl sulfide by the use of Sulfur dichloride and a solvent: Conant	62
411. Third progress report on the preparation of Dichloroethyl sulfide from Sulfur monochloride: Conant	65
412. Second report on the preparation of G-34 by the use of Sulfur dichloride and a solvent: Conant	70
413. Report on the preparation of Dichloroethyl sulfide: Gomberg	73
414. Report on Ethylene chlorohydrin: Kramer and Reid	85
415. A satisfactory method of destroying G-34: Conant	94
416. Fourth progress report on the preparation of G-34 from Sulfur Monochloride: Conant	98
417. Third report on the preparation of G-34 by the use of Sulfur dichloride and a solvent: Conant	102
418. Preparation of Dibromoethyl sulfide and Diiodoethyl sulfide: Conant and Mulliken	107
419. Answers to inquiries made by semi-large scale manufacturing division relative to G-34: Conant	109
420. The separation of Sulfur from G-34 prepared by the Monochloride process: Conant and Venable	111
421. Progress report – Organic Section: Conant	121
422. Production of Ethylene by the Kaolin Method: Giesy	139

423. Final report on the preparation of Dichloroethyl sulfide from Sulfur dichloride and a solvent: Conant	146
424. Report on Ethylene chlorohydrin: Allen, Loomis, Nelson, Grubb, Middleton, Peffer and Ransom	150
425. Report on Ethylene chlorohydrin: Boehner and Hahn	152
426. The determination of the purity of G-34 by the Freezing Point Method: Conant, Hartshorn and Richardson	155
427. Resumé of experiments on the preparation of Mustard Gas by the Sulfur monochloride Method – Chemical Research Offense – J.F. Norris – in charge.	159
428. Progress report – Organic Section: Conant	163
429. The action of Ethylene upon Selenium monochloride: Giesy and Sebrell	176
430. Effect of metals on the reaction between Ethylene and Sulfur monochloride: Conant	179
431. Second report on the separation of Sulfur from the G-34 prepared by the Monochloride process: Conant	183
432. Correction to report of April 15, 1918 on the effect of metals on the reaction between Sulfur monochloride and Ethylene: Conant	189

OR 8: Mustard Gas, Part II, (Reports 433-475), [2 copies]

433. Progress report – Organic section I: Conant	190
434. The use of metallic salts to prevent the separation of Sulfur in the synthesis of G-34: Conant	204
435. The mixing of G-34 with other toxic substances: Conant & Field	208
436. The action of Sulfur monochloride on Blaugas: Conant	210
437. Preliminary report on the disposal of the residue from the vacuum distillation of G-34: Conant and Hawkins	213
438. The effect of moisture and other volatile impurities on the synthesis of G-34: Conant and Smith	217
439. Progress report – Organic Section: Conant	221
440. Effect of impurities in Ethylene on the precipitation of Sulfur in the synthesis of G-34: Conant	226
441. The action of "Lime-Sulfur" on G-34: Conant and Reichert	230
442. A method for analyzing the mixed Oxsulfides prepared by the Commercial Research Company: Conant and Hartshorn	231
443. Report on 2,2' Dichloroethyl sulfide: Hale	237
444. Second report upon work in connection with the preparation of "Mustard Gas": Gomberg	239
445. The decomposition of Ethyl alcohol on passing through an Iron Tube at different temperatures: Venable	243
446. Report on the preparation of Ethylene: Reid	247
447. Preparation of Monochloroethyl sulfide and Monochloroethyl Methyl sulfide: Conant and Hartshorn	248
448. The volatility of crude G-34: Conant and Lee	251
449. Progress report – Organic Section I: Conant	255
450. Appendix to Report #0281.5C: Conant and Field	265
451. Second report on the disposal of the residue from the vacuum distillation of G-34: Conant and Hawkins	267
452. Action of Acetylene upon Selenium monochloride. The preparation of "Acetylene-Selenium-Mustard Gas", Beta Betadichloro-divinyl selenide: Boord	271

453. The nature of the by-products formed in the synthesis of G-34: Conant and Richardson	274
454. The Olefin content of the gases formed in the Hall Cracking Process: Hartshorn	282
455. Use of natural Bauxite as a catalyst in the catalytic preparation of Ethylene from ordinary Ethyl alcohol: Boord and Loudermill	288
456. Some G-34 data for the Edgewood Arsenal: Conant	291
457. The presence of more volatile impurities in G-34 and boiling point of pure G-34 at low pressure: Conant and Richardson	294
458. The mechanism of the formation of G-34 from Sulfur mono- chloride: Conant	296
459. Resistance to G-34: Jennings and Scott	302
460. Third report upon work in connection with the preparation of "Mustard Gas": Gomberg	305
461. The effect of Marble on the G-34 reaction: Hartshorn and Beebe	314
462. The solubility of G-34 in molten Sulfur: Hartshorn and Richardson	317
463. The effect of Kerosene and Gasoline on the melting point of G-34: Hartshorn	319
464. Report on rate of reaction of Chlorohydrin with Sodium sulfide: Hohn and Reid	321
465. The effect of Metallic Lead on G-34 at 160-190 Degrees Centi- grade: Hartshorn	324
466. Paint for detection of G-34: Clark and Bittles	326
467. The effect of Gasoline, Chlorobenzene, and Methyl Alcohol on the melting point of G-34: Hartshorn and Richardson	329
468. Preparation of 100% Chlorohydrin from 60% aqueous solution $\text{CH}_2\text{CH} \cdot \text{CH}_2\text{Cl}$	332
469. Effect of colloidal materials on G-34: Hartshorn	333
470. The effect of G-52 and of Acetone on the melting point of G-34: Hartshorn and Richardson	334
471. A comparison of the British Freezing Point Method for G-34 with the melting point in use in this laboratory: Hartshorn & Richardson	336
472. The precipitation of Sulfur from crude G-34 by dry and by moist Ammonia: Hartshorn and Beebe	338
473. The preparation of Sulfur monochloride from Sulfur precipitated from crude G-34: Hartshorn and Richardson	341
474. Carbon disulfide as a diluent for G-34: Hartshorn, Richardson and Beebe	344
475. A paint detector for liquid G-34: Wendt, Clark and Bittles	347

OR 8: Mustard Gas, Part III, (Reports 476-500), (originally Vol. I, Part II)

476. Observations upon the Selenious acid test for vapors of G-34: Wendt and Clark	1
477. A compound of Titanium tetrachloride with G-34: Wendt, Ford and Lebeson	3
478. Complex inorganic compounds as detectors for vapor of G-34: Wendt and Clark	7
479. The action of finely divided metals on G-34 – attempts to prepare Thiophene from G-34 – progress up to October 15, 1918: Vibrans, Gruse and Schuyler	13
480. Researches upon dyes as detectors for the vapor of H.S.: Wendt, Clark and Bittles	16

American University Technical Reports

481. Dichloroethyl sulfoxide: Waterhouse	43-A
482. Emulsion of Ricinoleic acid as a means of detection of H.S.: Wendt, Clark and Ford	44
483. Hydrolytic and catalytic effects as detectors of H.S.: Wendt, Clark and Lebeson	48
484. Observations upon and a comparison of various methods for the detection of H.S.: Wendt and Clark	52
485. Report on the production of Ethylene from Carbon monoxide and Hydrogen report #1 – results negative: Davidson	59
486. Progress report – organic section: Conant	69
487. Report on trip to Pittsburgh and Niagara Falls, on the problem of Ethylene manufacture from neutral gas: Davidson	72
488. Action of Acetylene upon Selenium monochloride. The prepara- tion of "Acetylene-Selenium-Mustard Gas", Dichlorodivinyl Selenide: Boord	74
489. Experimental work at the commercial research company on Chlorohydrin: Hartshorn	77
490. Report on trip at the Commercial Research Company's plant at Flushing, March 19-23, 1918: Hartshorn	81
491. Report on trip to the Texas Oil Company's plant at Bayonne, NJ, May 20-23, 1918: Hartshorn	84
492. Chlorination of a sample of residue from a semi-large scale chlor- ination of Sulfur precipitated from crude G-34 by Ammonia: Hartshorn	86
493. Supplementary report on the preparation of Selenium Mustard Gas and its derivatives: Boord, Bauer and Adams	87
494. Action of H_2F_2 on Thiodiglycol and G-34: Smith, Rosenthal and Ford	93
495. A paint detector for liquid G-34: Wendt, Lewis, Clark and Jones	96
496. Preparation of Ethyl selenocyanide CH_3CH_2SeCN : Johnson, Saxton and Deschavsky	104
497. Preparation of Selenium monochloride Se_2Cl_2 : Boord, Sebrell, Bauer and Adams	106
498. C.B. as a means of destroying H.S.: Wendt and Rosenthal	110
499. The preparation of "Mustard Gas". A summary of the work of Organic Unit No. 1 of the American University Experiment Station of the Bureau of Mines: Conant	111
500. Report on experiments on clay: Ripperton	150

OR 9: Incendiaries (Reports 501-526)

501. Incendiaries, report on progress: Ray	1
502. Incendiaries, report on progress, Nov. 26, 1917: Ray	11
503. Progress report, Incendiaries Research Laboratory, Dec. 31, 1917: Ray	17
504. Preliminary Report on Naval Signal Device: Ray	22
505. Incendiaries, Progress Report, Feb. 6, 1918: Ray	25
506. Preliminary report of materials, which can be used for generating gases to substitute for compressed air in the operation of several types of guns: Ray	38
507. Improvement of smoke-box mixtures. Report #1: Ray & Gore	41
508. Report to Ordnance Department concerning Type II Incendiary bomb: Ray	47
509. Development of materials, which can be used for generating	

gases to substitute for compressed air in the operation of several types of guns. Report #2: Ray & Ransom	49
510. Improvement of smoke-box mixtures, Report No. II: Ray & Gore, January 31, 1918	59
511. Nickel (G-145) Carbonyl vapor mixed with air: Ray, February 9, 1918	82
512. Report No. III on improvement of smoke-box mixtures: Ray & Gore, February 28, 1918	83
513. Toxic Smokes: Gore, February 28, 1918	89
514. Progress of the development of incendiary materials: Ray, March 31, 1918	94
515. Specification for incendiary material to be used in cardboard darts	115
516. Colored signal smokes: Ray & Herz, April 1, 1918	116
517. Report of conference with Mr. Henry J. Pain: Ray, December 14, 1917	126
518. Report on incendiary bomb: Reid & Hale	127
519. Report of conference with Mr. J. H. Deppler, Chief Engineer, Goldschmidt Thermit Co., New York City: Ray, December 14, 1917	128
520. Preliminary report on colored signal smokes and clouds recently developed: Ray, March 9, 1918	130
521. Incendiaries, report of progress: Ray	132
522. Incendiaries, report of progress: Ray, October 12, 1917	139
523. The production of colored clouds for aerial signaling: Peck, December 1, 1917	148
524. Specifications for red, yellow, blue, and green rocket and rifle grenade signal smokes and instructions for manufacture and assembly: Ray, May 9, 1918	153
525. Progress of research on colored signal smokes: Ray & Herz	163
526. Incendiary bombs. Report of progress: Ray	170

CATALYTIC SECTION (CS):

CS 1: Reports 1-13, Part I, W.D. Bancroft

1. Preliminary Report on Tetrachlorodinitroethane: Argo, James and Donnelly	1
2. Preliminary Report on Dithiosuperpalite: Argo and Murdock	5
3. Preliminary Report on Precipitation of Smokes in Hot-Cold Tubes: Argo and Anderson	12
4. Preliminary Report on Laminated Charcoals from Paper and Cloth: Argo and Draper	17
5. Preliminary Report on the Properties and Preparation of Super-palite, including a Study of the Intermediate Products Formed in the Chlorination of Methylchloroformate: Argo, Hood, and Murdock	20 A
6. Preliminary Report on the Catalytic Oxidation of Alcohol and Acetaldehyde to Acetic acid: Argo, Erskine, McDermott and Davidson (8/28/18)	21
7. Preliminary Report on the Bromination of Acetone in Acid Solution: Argo and Davidson	30

8. The Electric Preparation of Fluorine: Argo, Mathers, Humiston, and Anderson (12/1/18)	33
9. Chloropicrin from Chloroform and Nitrogen tetroxide: Argo and James (9/20/18)	51
10. Second Preliminary Report on the Catalytic Oxidation of Acetaldehyde to Acetic acid: Weiser and Erskine	55
11. Report on Tetrachlorodinitroethane: Argo, James and Donnelly	80
12. Chlorination of Diethyl Ether in Presence of Catalysts: Weiser, James and Finnegan	87
13. Use of Silent Discharge in Inducing Chemical Reaction: Weiser and Gross	96

CS 2: Reports 14-25, Part II, W.D. Bancroft

14. Attempts to Prepare Perchlorethylene According to Schutzenberger's Method: Murdock	108
15. Action of Fluorine on Organic Compounds: Burr Humiston	116
16. The Action of Chlorine on Sodium carbonate: Weiser and Hood	121
17. The Preparation of Superpalite: Hood	123
18. The Preparation of Tetrachloroethylene: Weiser and Wightman	134
19. Electrosynthesizing Acetic acid from Acetaldehyde: Christopher	155
20. Charcoal from Carbon Black: Morrell	167
21. Charcoal from Vulcanized Fibre Board: Morrell	183
22. Report on Method of Charcoal Preparation: Morrell	191
23. Synthetic Adsorbent Charcoals: Morrell (10/15/18)	194
24. A Study of the Colloids Used in Connection with the Preparation of Synthetic Adsorbent Charcoals: Morrell	210
25. A Method for the Determination of Moisture Designed for Factory Control Work: Morrell and Dundon	216

DISPERSOID SECTION (DS):

DS 2: Reports 51-76, R.C. Tolman

51. Effect of Temperature on the Efficiency of Production of Smokes by Explosive Dispersion: Gerke and Jennings	1
52. A Theory of Explosive Dispersion: Wells and Gerke	4
53. Modification and Design of Cottrell Smoke Precipitation Apparatus Adapted to Determine Smoke Concentration Analytically: Ryerson, Smith, and Brooks	8
54. The Use of an Explosive Mixture of Sodium acetate and Sodium nitrate to generate a Toxic Smoke: Smyth, Kruse, and Jennings	10
55. The Use of Explosive Mixtures of Barium Salts to Generate a Toxic Smoke: Smyth, Jacobi, and Jennings	16
56. Smoke Production by Thermal Dispersion and the Dispersoid D.M. Smoke Candle: Vliet, Wroby, and Hurd	20
57. The Use of Bromoacetophenone as a Toxic Smoke: Smyth, Charleston, Jacobi, Holt, and Brooks	25
58. The Efficiency of Smoke Production as affected by the compactness with which the TNT is loaded: Braham, Kruse, and Wroby	27

59. A Study of Smokes Obtained by a Controlled Method of Production: Vliet, Pierce, Dougherty, Jennings, and Tolman	29
60. The Use of Dinitrochlorobenzol, Mononitrodichlorobenzol and Orthonitrochlorobenzol as Toxic Smokes: Smyth, Charleston, Jacobi, & Brooks	33
61. Penetration Tests Using Uniform Smoke Density: Guernsey, Wrightsman, Walters, and Tolman	36
62. Variation of Penetrating Power with Rate of Flow: Guernsey, Wrightsman, Walters, and Tolman	38
63. Investigation to determine whether there is Selection of Particles in Penetration of the Standard Filter by Smoke: Guernsey, Wrightsman, Walters, and Tolman	40
64. Penetrating Power of L-1 and Mustard Oil (Pure and Mixed with Coal Tar): Guernsey, Wrightsman and Walters	43
65. Amount of Oxidation Occurring in the Cottrell Tube as used by this Division in Analytical Determination of Smokes: Ryerson, Smyth, & Dougherty	45
66. Relative Distribution of Explosive and Toxic for Maximum Smoke Production: Braham, Krase, Herman and Wroby	48
67. Efficiency of Smoke Production as affected by the Strength of Containers of the Explosive and Smoke Producing Material: Braham, Krase, Herman and Wroby	51
68. Large Scale Production of Smokes by the Explosion Method: Beyer, Krase and Dern	53
69. Dithiosuperpalite as a Toxic Smoke: Smyth, Charleston, Jacobi and Brooks	63
70. Dimethyl Sulfate and Xylol Bromide as a Toxic Smoke: Jacobi, Holt, Charleston and Smyth	66
71. Methyldichloroarsine and Triphenylarsine as Toxic Smokes: Charleston, Jacobi, Holt and Smyth	69
72. A Comparison of the Properties of Pure G-349, Mixtures of G-349 and G-76, and Pure G-76 as Toxic Smokes: Smyth, Charleston, Jacobi and Holt	72
73. Report on the Penetration of Smoke made by "Smokefier": Guernsey, Vliet, Wrightsman and Walters	75
74. Effect of a Confining Chamber on the Smoke produced by the Explosion of Small Bombs: Braham, Krase, Herman and Wroby	78
75. Clogging of Canisters – A – Attempt to Destroy Absorptive Effect of Charcoal by Saturating it with a Non-Toxic: Bell, Brooks & Barrett	82
76. Effect of Explosive Containers on the Density of Smokes Produced with typical 150 gr. HE, 150 gr. Anthracine Experimental Dispersoid Bombs: Capt. O.S. Beyer	88

DS 3: Reports 77-100, R.C. Tolman

77. Clogging of Canisters – B – Plugging Smoke Filters by SnCl_4 Vapors: Bell, Brooks and Barrett	90
78. Use of L-1 and G-34 as Toxic Smokes: Smyth, Charleston, Jacobi, Holt and Brooks	92
79. Reliability of a New Method of Lamp Regulation in the Tyndall-meter: Pierce	97
80. Dispersion of Phenyldichloroarsine by the Explosive Method using	

American University Technical Reports

TNT and Tetryl: Braham, Krase, Herman and Wroby	100
81. Clogging of Canisters – C – The Clogging of Smoke Filters by SnCl ₄ Smoke: Bell, Dougherty and Barrett	104
82. Use of Iron Containers for Bombs in the Investigations of Dispersion by the Explosive Method on Medium Scale Tests: Braham, Herman, Krase and Wroby	107
83. Clogging of Canisters – D – The Clogging of Smoke Filters by Oil Smoke: Bell, Dougherty, Barrett and Jarvis	110
84. Hangfire measurements on ammunition from Frankford Arsenal and Peters Cartridge Co.	112
85. Effect of the Strength of Container on the Smoke Produced by Explosive Dispersion of Two Solids: Beyer, Krase, Dern, McQuade, and Hurd	126
86. Relation of the Shape of Bomb to its Smoke Producing Capacity: Beyer, Krase, Dern, McQuade and Hurd	129
87. Effect of a Variation in the Quality of Explosive on the Smoke Produced: Beyer, Krase and Dern	133
88. Supplementary Report on the Ratio of Explosive to Dispersoid Material: Beyer, Krase and Dern	135
89. A Comparison of the Quantity of Smoke Obtained from Similar Bombs Enclosed in Fragile and Strong Containers: Braham, Krase, Herman and Wroby	137
90. Dispersion of Chloroacetophenone by the Explosive Method: Braham, Herman and Fraser	142
91. A Brief Study of the Relative Dispersive Power of TNT, Tetryl, TNA and Nitrostarch, and of the Smoke Produced from each Explosive alone: Braham, Herman, Larson and Fraser	148
92. The Mixing of Toxic Materials with Explosives: Smyth, Charleston, Jacobi and Holt	151
93. Clogging of Canisters – E – Comparison of Paper Smoke Filters: Bell, Dougherty, Barrett and Jarvis	167
94. The Use of Mixtures of Smoke-Producing Materials with a Chlorate Explosive: Smyth, Jacobi, Charleston and Saltzmann	170
95. Effect of Aluminum upon the Dispersive Power of an Explosive: Smyth, Jacobi, Charleston and Guernsey	174
96. The Clogging of Canisters – Comparison of Smokes and Mists which clog paper #PV2: Bell, Dougherty, Barrett and Jarvis	179
97. The Clogging of Canisters – Miscibility of Various Toxics and Oils: Dougherty, Barrett and Jarvis	181
98. Production of Penetrating Lachrymatory Smokes: Smyth, Guernsey, Jacobi, Wrightsman and Walters	183
99. Use of Mixtures of G-67 and Arsenic bromide as Toxic Smokes: Smyth, Charleston, Jacobi and Holt	188
100. Hangfire Inspection Report Small Arms Ammunition	191

DS 4: Reports 101-120, R.C. Tolman

101. The Concentration of Certain Toxic Smokes as determined by the Modified Cottrell Method: Smyth, Brooks, Fraser and Herman	1
102. The Clogging of Canisters – The Penetration through Charcoal and through Paper by Oil Smokes: Bell, Dougherty, Barrett and Jarvis	8
103. The Size of Particles in Toxic Smokes: Wells, Gerke and Olin	10

104. Preliminary Report on the Effect of Detonation on the Penetration of Smokes: Charleston, Holt, Hudson, Jacobi and Smyth	18
105. Description of German Smoke Filters: Bell	20
106. The Use of Diphenylcyanarsine as a Toxic Smoke: Smyth, Charleston, Jacobi, Holt and Brooks	22
107. Penetration by Smokes through Paper of German Filter: Bell, Dougherty, Barrett and Jarvis	24
108. Report on the use of a Mustard Gas – TiCl ₄ Compound as a Toxic Smoke: Smith, Jacobi, Charleston, Holt and Hudson	26
109. A Method for obtaining complete protection from Toxic Smokes: Gerke	28
110. The Use of Hexanitrodiphenylamine on intimate Mixtures with Smoke-Producing Materials: Smith, Jacobi and Saltzman	30
111. The Clogging of Canisters – The Clogging and Penetration of Duplicates of the German Smoke Filter by Toxic Smokes: Bell, Dougherty, Barrett and Jarvis	33
112. The Penetration of D.M. Smoke produced by Explosive Dispersion in a Ten Cubic Meter Chamber: Guernsey, Wrightsman & Walters	35
113. Test on D.M. Candles at Lakehurst Proving Ground: Tolman	37
114. The "Mixture" Type of Dispersoid Shell: Krase, Buddington, Dern and McQuade	42
115. Penetration of G-76 Smokes Made by Explosive Dispersion in a Ten Cubic Meter Box: Guernsey, Wrightsman and Walters	49
116. A Comparison of the Penetration of D.M. Smokes produced by Thermal and Explosive Dispersion: Guernsey, Wrightsman and Walters	52
117. The Clogging of Canisters – The Relation between the Clogging and the Penetration of Paper Smoke Filters: Dougherty, Barrett, Jarvis and Smyth	53
118. Preliminary Report on the Use of Phenyl-Chloracetate, p-Methoxy-Chloracetophenone, p-Methyl-Chloracetophenone, and Chloracetoxyline as Smokes: Smyth, Charleston, Jacobi and Holt	56
119. Report on the Smoke-Producing Properties of Diphenyl: Smyth, Jacobi, Charleston and Holt	59
120. The Clogging of Canisters – The Value of TiCl ₄ as a Clogging Smoke: Dougherty, Brooks and Hudson	61

DS 5: Reports 121-150, R.C. Tolman

121. A Kinetic Theory of Smoke Filtration: Tolman, Gerke and Wells	63
122. Test on Flight Caps for 75 mm Gas Shell: Tolman	65
123. A Comparison of the Penetrating Power of Smokes from Dispersoid and Pyrotechnic D.A. Candles: Guernsey, Herman, Dougherty, Hudson, Anderson, Wrightsman, Jarvis and Walters	67
124. Penetrating Power of D.M. Candle Smokes as produced in the field: Guernsey, Herman, Dougherty, Anderson, Wrightsman, Jarvis and Walters	70
125. A modified three-inch Stokes Mortar Shell for Thermal Dispersion: Tolman, Vliet and Wroby	73
126. Preliminary Report on the Distribution of Mustard Gas from a 75 mm Gas Shell, using ordinary Mark IV Boosters, Enlarged	

Boosters, and admixture of CO ₂ : Tolman, Krase, Buddington and Dern	77
127. Report on Tests on Samples of O.S.U. 12 and O.S.U. 15 as Toxic Smokes: Smyth, Holt and Jacobi	93
128. Factors Influencing Penetrating Power of D.M. Smokes: Guernsey, Wrightsman and Walters	95
129. Properties of the Smoke Produced by Fluosulfonic acid: Smyth, Charleston, Jacobi, Holt and Hudson	98
130. The use of Ethyl Fluosulfonic acid as a toxic smoke: Smyth, Jacobi, Hudson and Holt	101
131. The use of D.M. and D.A. in Candles: Smyth, Charleston and Holt	103
132. The use of Chlorosulfonic acid as a toxic smoke: Smyth, Charleston, Jacobi, Hudson and Holt	105
133. Absolute Standardization of the Tyndall Beam: Charleston, Holt and Smyth	108
134. The use of Phenylnimido Phosgene as a Toxic Smoke: Smyth, Jacobi, Hudson, Charleston and Holt	110
135. The use of Chloroacetyl diphenyl as a Toxic Smoke: Smyth, Jacobi, Hudson, Charleston and Holt	112
136. The use of Bromacetamide as a Toxic Smoke: Smyth, Jacobi, Holt and Hudson	114
137. The use of Juglon and Juglon Acetate as Toxic Smokes: Smyth, Jacobi, Holt and Hudson	116
138. The use of Chloracetanilide, o-Chlor-Chloracetanilide, p-Chlor-Chloracetanilide, p-Brom Chloracetanilide, and m-Nitro Chloracetanilide: Smyth, Jacobi, Holt, Hudson and Brooks	119
139. The Dispersoid D.A. Smoke Candle: Vliet, Anderson and Fraser	122
140. A Modified Hand Grenade for the Thermal Dispersion of D.M.: Vliet and Wroby	126
141. The Explosive Dispersion of D.A. and D.M. from the 3" Mark III Stokes Mortar Shell: Vliet, Krase, Krase and Wroby	128
142. The Stability of the Mixtures used in the Dispersoid D.M. and D.A. Smoke Candles: Vliet, Anderson and Olin	131
143. Effect of Detonation on Penetration of Smokes: Charleston, Holt, Jacobi and Smyth	134
144. The use of Mercury Trichlor ethylene as a Toxic Smoke: Smyth, Jacobi, Holt and Hudson	137
145. The use of Ethyl cyanide as a toxic smoke: Smyth, Jarvis, Jacobi and Hudson	139
146. The use of Symmetrical Dichloroacetone as a Toxic Smoke: Smyth, Jacobi, Holt and Jarvis	141
147. Report on the use of M-1 Oxide as a Toxic Smoke: Hudson, Jacobi, Holt and Smyth	143
148. Report on the use of Chloracetothienone as a Toxic Smoke: Hudson, Jacobi, Jarvis, Holt and Smyth	145
149. Vapor Pressure of a Mixture of H.S. and CO ₂ : Krase, Pitman and Penland	147
150. The use of mixtures of D.M. and TNT in 75 mm Shell for the Production of Toxic Smokes: Krase, Buddington, Dern and Hurd	149

COORDINATING COMMITTEE ON ANALYTICAL AND RESEARCH METHODS (CCARM):

CCARM: Methods of Testing Absorbents, Part I

General Analytical Methods

1. Introduction
2. General Considerations Relating to the Accuracy of Tube Tests
3. Specifications for Sample Tubes
4. Determination of Area of Absorption Tubes
5. Calibration of Flow-meters and Adjustment of Sample Tube to Atmospheric Pressure
6. Preparation of Sample for Test
7. Method of Filling Sample Tube
8. Additional General Requirements
9. Miscellaneous

Standard Tube Test with Chlorine

Standard Long G25 Method

Accelerated G25 Method

Accelerated G25 Method, First Revision

Standard G52 Method

G49 Tube Test

Standard G-43 Method

Standard Tube Tests with G-7

Standard G-178 Tube Test

CCARM: Methods of Testing Absorbents, Part II

Standard SO₂ Tube Test

Standard Method for Screen Analysis

Discussion of Hardness Testing with Provisional Method

Standard Detonation Method for Man-House Tests on Filters with G-76
(Including Analytical Methods for G-76 in Air)

Proposed Standard Tube Tests on 12-24 Mesh Material

Standard Method of Measuring the Pressure Drop through Smoke Filtering
Materials

Standard Flange Tests for Smoke Filter with F-10

Supplementary Notes on Standard Flange Test for Smoke Filters with F-10

Standard Flange and Canister Tests of Smoke Filters against Tobacco Smoke

CCARM : Minutes of Conferences

MISCELLANEOUS REPORTS (MR):

MR : Minutes, Carbon Monoxide Conference

Report of conference on G-31 absorbent	1
Recommendation of fourth conference on G-31	3
A report of the fifth conference on Carbon Monoxide absorbent	4
Memorandum	6
Memorandum: Seventh conference – G-31	8
Memorandum: Conference on G-31 canisters	10
Informal conference on G-31 canisters: Experiments for G-31	12

Informal conference on G-31	14
G-31 conference	15
Report of conference on G-31 protection held August 10 th in Lieut. Col. Lamb's office	19
Report of conference on G-31 protection held August 14 in Lt. Col. Lamb's office	21
Proposed tests on CM-3 canisters with Hoolamite fillings	23
Minutes of conference held by co-committee in Dr. W.K. Lewis' office	25
Minutes of G-31 conference held in Lt. Col. Lamb's office	27
Minutes of conference on Navy Co canister held in Lt. Col. Lamb's office	30
Minutes of conference held on G-31 in Col. Lamb's office	32
Memorandum of meeting of committee on HC canisters (held in Dr. Lewis' office)	35
Memorandum of meeting on HC	37
Minutes of conference on HC at rare metals product company	39

MR: Official Methods for the determination of Arsine, Methyldichloroarsine, Ethyldichloroarsine, and Diphenylchloroarsine, Committee on Analytical Methods, Washington, DC, 1918

Arsine

- I Properties
- II Abstract of Method
- III Preparation and Standardization of Solutions
- IV Details of Operations
- V Calculations
- VI Notes

Methyldichloroarsine

- I Properties
- II Abstract of Method
- III Preparation and Standardization of Solutions
- IV Details of Operations
- V Calculations

Ethyldichloroarsine

- I Properties
- II Abstract of Method
- III Preparation and Standardization of Solutions
- IV Details of Operations
- V Calculations

Diphenylchloroarsine

- I Properties
- II Abstract of Method
- III Preparation and Standardization of Solutions
- IV Details of Operations
- V Calculations

MR: Summary Report on Felt for Smoke Filters, John B. Dickson

INTRODUCTION	2
HISTORY OF THE DEVELOPMENT OF FELT FOR SMOKE FILTERS	6
PART I. FELT MANUFACTURE.	
<u>Wool</u>	9
Varieties	9
Structure of Fiber	11
Density	21
Chemical Properties	21
Wool Cleansing	22
Burr Picking	23
Carbonizing (Extracting)	24
<u>Manufacturing Processes</u>	26
Blending	27
Carding	28
Hardening	30
Fulling	32
Finishing	34
<u>Bibliography</u>	36
<u>Manufacture of Felt for Smoke Filters</u>	38
Questionnaire	38a
Specifications	39
Typical Reports on Mill Practice	40
Plots of Tests on Last Mill Production	44
PART II. THEORETICAL CONSIDERATIONS AND EFFECT OF VARIABLES	45
<u>Theories of Smoke Filtration</u>	46
<u>Theory of Felt Formation</u>	54
Summary	59
<u>Microscopic Examination of Felt</u>	60
<u>Effect of Variables</u>	64
Kind of Wool	64
Blending	68
Carding	69
Hardening	70
Fulling	70
Buffing	83
Pressing	89
Impregnating and Dyeing	95
Summary	98
<u>Uniformity of Felt</u>	100
PART III. TESTING	102

<u>Standard Flange Test for Smoke Filter with F 10</u>	104
<u>Supplement to Standard Test</u>	123
<u>Additional Suggestions on Testing by Corporal Davis</u>	130
<u>Recommended Change in Standard Method</u>	131
<u>Effect of Variables in the Production of the Standard Sulfuric Smoke</u>	132
<u>Indicator Paper Test</u>	133
<u>Comparison with Man-House Tests</u>	136
<u>General Considerations on Testing</u>	137
PART IV. MISCELLANY	139
<u>Specking: Tar Spots</u>	140
<u>Canister Shaped Felt</u>	142
<u>Pressure Drop at Different Rates</u>	144
<u>Miscellaneous Tests</u>	145
List of Reports	148
APPENDIX. COLLECTION OF DATA SAMPLES OF FELT (BUFFED AND UNBUFFED)	149-189 190

MR : Work of Research Division on Problems under Investigation, Technical Division, A.E.F., Report V-1 through V-16

MR : Presentation of the Goodrich-Lakeside Mask and a Study of the Principles Involved in Mask Design, Major R.G. Pearce and W.C. Geer Ph.D, Editorial Section, Vol. 59, Oct 24 1918

Description of the Goodrich-Lakeside Mask	2
Specifications which must be met by the fighting mask	4
Introduction	10
Primary specification	12
Physiological specifications	12
Breathing requirements	12
Resistance to expiration	14
Dead space	15
Protection of eyes	17
Range of vision	17
Clarity of vision	18
Comfort of mask	18
Mechanical specifications	20
Materials of construction	21
Gas tight union	21

Bands and adjustment	23
Inhalation tubes	25
Relationship of inhalation tube to clarity of vision	26
Exhalation valve	29
Eye pieces	30
Specifications for carrier and tube	31
Position	31
Tube requirements	34
Service specification	35
Production	35
Conclusions	37
Analysis of the existing masks	38
Akron Tissot Mask	40
Kops Tissot Mask	45
Kops Monroe Mask	46
Connell Mask	47
Analysis of the Goodrich-Lakeside Mask	47
Exhibits	55
I. The physiological requirements of air for normal respiration under different degrees of exercise	55
II. The minute volume of air required to meet the demands for very sudden and strenuous work	57
III. The time relationship of inspiration, expiration and rest to the respiratory cycle, and the effect that resistance to inhalation has on relationship	58
IV. The effect of resistance to breathing	60
V. The effect of resistance on the minute volume of air re-spired	63
VI. The maximum rates of inhalation and exhalation and the effect of resistance on minute volume of air breathed	65
VII. The effect of dead air space on minute volume of air breathed.	69
VIII. The harm of dead air space	75
IX. Measurement of leakage of masks by Pearce-York apparatus	76
X. Determination of range of vision of various masks	80
XI. The Lakeside-Goodrich apparatus for determining the pressures exerted by the bands of the mask	82
XII. The effect of adjusted masks upon bloodflow in the temporary artery	84
XIII. Description of the Lakeside-Goodrich machine for determining the gas-tightness of a mask irrespective of the face seal	86
XIV. The Hull method for determining the maximum tension exerted by the harness of a mask	88
XV. Analysis of bands used in head harness of mask	89
XVI. Relationship of mask leakage determined by the Pearce-York method to that determined by the gas chamber tests	92
XVII. A method of estimating Chloropicrin	94
XVIII. Description of the Pearce-York apparatus for testing leakage of gas masks	108
XIX. Comparison of head measurements	109
XX. Pressure of masks	112

XXI. Effect of changing direction of pull of head harness	114
XXII. Leak-in of A.T. and K.T. masks in gas chamber	117
XXIII. Effect of mask resistance to inspiration	123
XXIV. A comparison of resistances between Geer ... and flutter valves	126
XXV. Gas-absorption power of A.T. and K.T. face pieces	146
XXVI. Resistance of corrugated tubing	150
XXVII. Rating chart for gas masks	153

Appendix A –

Preliminary survey of the physiological factors which must be considered in mask design and the importance of these factors to the soldier	155
--------------------------------------------------------------------------------------------------------------------------------------------	-----

Appendix B –

Field test of the Goodrich Lakeside masks	187
-------------------------------------------	-----

Index

MR: Flaming liquids

Introduction	102
Development of the Apparatus	
Description of Overseas Models	102
Oil Reservoir	103
Propellants	103
Size of Nozzle	103
Ignitions	104
Investigation of Oils	105
Future Work	106